Agriculture

PUBLISHED 6d MONTHLY

AGRICULTURE

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Editorial Offices: St. Andrew's Place, Regent's Park, N.W.1 (*Phone: WELbeck* 7711)

VOL. LVIII No. 5 AUGUST 1951

Contents

Cover Photograph

New Forest Ponies near Lyndhurst .. .. *Crown Copyright*

AGRICULTURE

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

VOL. LVIII No. 5 AUGUST 1951

ADVISORY WORK ON LOW-OUTPUT FARMS

W. B. MERCER, C.B.E., B.Sc., N.D.A.

Provincial Director,
National Agricultural Advisory Service, West Midland Province

The emphasis today on greater farm productivity requires the adviser to consider not single problems, as once upon a time, but rather their influence on the efficiency of a farm as a whole.

"WHEN I use a word," said Humpty Dumpty, "it means just what I choose it to mean," and cited "impenetrability" by way of illustration. We follow in his train in our usage of the word "efficiency". The economist thinks, rightly enough, in terms of returns per £1 of capital invested ; the sociologist, with justice, of wealth created per man-hour ; many a man is content to judge by returns per quantum of thought and worry ; while agricultural advisers must keep output per acre in the forefront of their minds. Certainly no farmer today can be considered efficient unless he is producing at a reasonably high rate those crops which the nation requires ; that is part of the bargain implicit in the Agriculture Act, 1947.

We cannot, of course, contend that high production necessarily leads to higher profits – still less to higher net income, when tax has been deducted. The relationship of profits and prices has in the past been generally stated in Lawes' famous negative that "high farming is no remedy for low prices". But in recent times it has been shown over and over again how increased expenditure gives rise to increased profit margins. The case of fertilizers on potatoes is one of the easiest to prove ; that of T.T. milk, though more complex, even more striking. Though all financial calculations in recent times are to some extent vitiated by the fact that we have been living in a period of rising prices, there can be little doubt that we are safe in proceeding on the assumption that high output is generally justified by the profits it earns.

This necessary emphasis on output has greatly widened the responsibilities and field of work of the farm adviser. In days gone by he was called upon for opinions on a wide range of farming topics ; but each inquiry could be, and was, treated individually, without too much concern about the influence of the point at issue on the farm as a whole. Today the issue in every farm problem is : "Does the matter materially influence total output and, if so, in what ways ?" Thus willy-nilly, the adviser must visualize a system of management and, in his own mind at least, construct a "philosophy" for the farm. In effect, that is the task every surveyor sets himself in carrying out a farm survey.

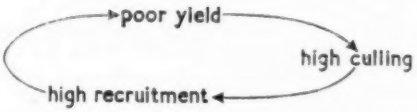
In a general way all experienced advisers know the common weaknesses of the farming in their areas. To pin-point them it is necessary to examine at least a sample of farms where management is defective, or believed to be so.

In the West Midland Province of the N.A.A.S. we attempted this task last year by selecting at random in every district three farmers who had been classified B and, for the sake of comparison, three occupying similar holdings who were classified A. A detailed report was made on the B farmers, the underlying reasons for shortcomings and the apparent steps needed to make improvements. In most cases rough assessments of the output of the farms involved were made by the use of a standard record card. The A farmers were as a rule found to be producing at a markedly higher level than the B farmers ; but admittedly a few of the A classifications were hard to justify by reference to the figures. I have drawn freely on these reports in preparing the following notes.

On a certain proportion of farms in every part of the country natural circumstances set severe limits ; altitude, roads, buildings, water supplies and, above all, rural population can present insuperable obstacles to immediate improvement. In the Midlands, as in most of England, the proportion of such farms is not very high. On normal farms the defects of management fall into two groups : faults of design, and of execution.

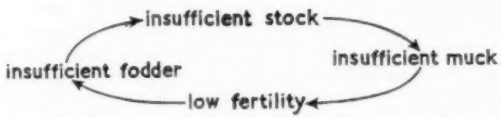
Design Defective farming systems nearly always involve a cycle of events. On arable land it is commonly a succession of poor crop—weed—poor crop, and it is almost academic to argue whether the weed is cause or effect, for it is both. The case for big crops can be argued from the simple standpoint of keeping the land clean.

On low-grade stock farms, particularly dairy farms, a vicious cycle is set up by the short milking life of the cow. Practically all the heifers born, good, bad and indifferent, must be retained to keep up the herd strength, and we get a cycle like this :



Farmers in the grip of this cycle plainly carry a dead weight of far too many unproductive animals. This may or may not be a simple question of inherent capacity of the heifers ; very often the problem is complicated by disease ; but it is certain that a sound breeding policy must be introduced. Where improved breeding is linked with improved health measures, a transformation can be effected in a few years. It is astonishing how quickly on a good, self-contained T.T. farm an actual surplus of heifers arises.

The commonest case on a stock farm is, however, more complicated. It runs :



A variant of this is where the numbers of stock are adequate to the acreage,

but their output of milk, or their growth-rate as the case may be, is poor because they are badly fed. It is noteworthy that in many such cases the symptom that first strikes the visitor—the poor quality of the stock—is not the prime cause of the cycle ; the stock are themselves victims.

The starting point for the adviser on all such farms is the fertility of the land. In days gone by many a man has solved the problem by the simple expedient of buying fodder and corn to feed the stock to make the muck to grow the crops. In rare cases fodder can still be bought in, as the shortest way out of the difficulty. Normally the starting point is liberal use of fertilizers. Fortunately we have a good deal of information about lime and fertilizers ; we have a weapon of almost mystical potency in soil analysis, and fertilizers in reasonable quantity give visible results ; we can guarantee a return. Quite legitimately, it can be argued that anyone spending less than his rent on fertilizers is farming badly.

Grassland of one sort or another is usually the key to the fodder problem. It is rare indeed to find good grass on a low-grade farm, while the neglect which can be seen almost passes belief. " No fertilizers have been applied on this farm since 1939 " runs the report on one of the farms examined in the series referred to above !

Thus on a stock farm the adviser may have a very complicated job, involving every part of the land, one or more of the stock departments, the men who are working in them, and the farmer himself. Usually he has to make up his mind which of the faults is of most consequence, and how it can be remedied most quickly. He must be prepared to discard technical points dear to the heart of every scientist. It is of little use talking of milk recording if the cattle are manifestly not getting enough fodder (I doubt whether recording is, in any case, worth while under 700 gallons per cow). He must judge what standard of herd management is practicable with the labour available. Silage may or may not be advisable ; but it is a secondary matter to producing the crop to ensile.

Execution Low-output farms are generally " behind with their work". Why ? The answer is to be found in the human frailty of the occupiers. A one-man unit, a farm, commonly experiences every phase in the drama of human life : the intense struggle of the early years when the only deterrents are lack of fluid capital and the fact that a day has only twenty-four hours ; the period of prime when early efforts are yielding fruit and the flame of life is still bright ; the phase of stability and perhaps of caution ; and then the slow decline, as a man begins to count the years in the opposite direction. We have not got, we never shall have, a world in which everyone is at the height of his powers. Always it is peopled with men in varying stages of virility, with varying zest for progress. At all times, some farms will be held by widows struggling to maintain the family inheritance until the children grow up ; some occupied by men in failing health.

It is not easy for an outsider to analyse the manner in which another man's mind works, to determine the reasons for a farmer's decisions. But this much can with confidence be asserted—that improved output comes only from a *real desire* to improve output. By far the commonest problem encountered in work on low-output farms is the lack of any apparent desire to improve things. The real foundation of advisory work on such farms is not technicalities themselves, but the evocation of interest in technicalities.

VARIETY AND MANURIAL TRIALS WITH WINTER OATS IN HERTFORDSHIRE

H. W. GARDNER, B.A.
Hertfordshire Institute of Agriculture, St. Albans
and
J. B. HUTCHINSON, Ph.D.
Cereals Research Station, St. Albans

SOME of the results of the war-time and post-war trials with varieties of winter wheat in Hertfordshire have been described in this JOURNAL [1,2]. During the same period, but on a smaller scale, trials have also been conducted with varieties of winter oats. The methods used in the field were very similar to those employed for wheat except that, as combine harvesting is not so common with oats, most of the centres were cut by binder. An advantage of this method is the information gained regarding the weight of straw, a matter of considerable importance in British agriculture, as oat straw makes a large contribution to the winter feeding of livestock.

From the 1946 harvest onwards, samples of the grain have been examined for percentage of empty and "needle" oats ; weight of 1,000 kernels ; percentage of kernel in the complete grain ; oil, protein, and ash content of the kernel ; ash content of the husk. Since at least 90 per cent of the oil and protein and all of the true starch of the oat is within the kernel, the feeding value of oats is determined chiefly by the amount of kernel and its chemical composition. The "crude protein" of the husk has been measured in numerous cases but as, apart from considerations of digestibility, it is only about one-twentieth of what is present in the kernel, the figures for the husk are of little importance and have been omitted.

Gross Yields of Grain The results of fourteen trials in the four harvests, 1944, 1946, 1947, 1948, (1945 having been missed owing to the late delivery of the seed corn) are given in Table 1.

Table 1

Yields of Grain 1944, 1946-47-48
cwt. per acre

Year	No. of Trials	Mean Yield	S.147	Grey Winter	Black Winter	Picton	S.172	For Variety Means	
								Standard Error	Sig. Dif.
1944	3	22.2	24.3	24.5	20.6	22.5	19.3	1.24	4.03
1946	4	23.3	27.5	24.1	22.4	22.6	20.1	1.01	3.12
1947	4	17.1	15.2	17.8	18.0	18.6	15.8	0.85	2.66
1948	3	22.7	23.0	21.2	25.8	22.1	21.4	2.51	8.10
Av. of 14 trials		21.19	22.36	21.79	21.51	21.32	18.99	0.70	1.99
Order			1	2	3	4	5		

For the whole series of trials the average yield was just over 21 cwt. The ultra-short oat, S.172, was significantly below the other four, as would be expected on soils whose general level of fertility is represented by this

seven-quarter yield. The remaining four did not differ significantly from one another, the extreme difference being 1.04 cwt. between S.147 and Picton, which is only just over half the amount necessary for significance at the 5 per cent level.

It is interesting to compare these average results for oats and their standard errors with those of the winter wheats for the same county given in the article referred to above. The wheat, in thirty trials, averaged 20.91 cwt. per acre, 0.28 cwt. below the average of the oats. The standard error per plot for the wheat trials was 2.58 cwt. or 12.3 per cent of the general mean; for the oat trials it was 2.6 cwt. which was also 12.3 per cent of the general mean. The majority of the wheat centres were cut by combine. In the case of the oats all but three centres were cut by binder, the method being to weigh all the sheaves from a binder-width two or three chains long (noting carefully for each variety the actual number of rows of corn cut), to take three sheaves, without conscious choice, from the collection of sheaves just weighed, to put them in a sack and weigh without delay. The sacks containing the three sheaves from each variety were suspended by hooks from a metal framework under a Dutch barn and threshed at any convenient time during the winter. Before threshing, the sacks were weighed again to give an estimate, corrected by the loss of moisture during the drying period, of the yield of total produce, i.e., grain plus straw. It is a matter of considerable interest to the field experimenter that the additional operations involved in the binder method of harvesting the plots have given almost exactly the same error per plot as the combine method. This error may be compared with 11.3 per cent given by Garner (3) for randomized block experiments on cereals at the Rothamsted and Woburn Experimental Stations.

The average yields of grain give no indication of the harvesting difficulties since, in experiments, considerable trouble will usually be taken to cut all the corn on a plot even if badly lodged. In these trials the fertility was never high enough to send S.172 down ; occasionally this variety was so short as to cause trouble in tying the sheaves ! S.147 was sometimes, but not often, flat by harvest time ; Grey and Black Winter were often difficult to cut and did not differ appreciably in this respect ; Picton was intermediate between the Winters and S.147.

Yield of Straw and Percentage of Grain in Total Produce Table 2 gives a comparison based on eleven centres (three in each of the four years except 1948) of the average yield of total produce for the five varieties, the corresponding weights of grain and straw, and the percentage of grain in total produce. A statistical analysis has not been carried out, but the standard error for the grain and straw would be comparable with that already discussed, namely, about 12 per cent per plot of the average yield, and that for the percentage of grain in total produce, owing to its narrower range of variation, would be very much smaller.

On the average, the weight of grain is just above 40 per cent of the total produce ; omitting the exceptionally short-strawed variety, S.172, it is extremely close to 40 or, in other words, the weight of straw is one-and-a-half times the grain. S.172 is appreciably above the average of the other varieties, but the difference is still comparatively small. The same was found to be true of the very short-strawed variety of winter wheat, Desprez 80 ; when yielding the same grain per acre as a taller variety, it gave only a little less straw. If the grain/total-produce ratio is regarded as a measure of the "efficiency" of the plant, S.172 is significantly more efficient than the other

four, but the degree of this superiority is not great. In any case, such a difference is valueless unless accompanied by a yield at least equivalent to other commonly used varieties.

Table 2

Total Produce, Grain, Straw, and Grain/Total-Produce Ratio
Average for Eleven Centres, 1944-48

	S.147	Grey Winter	Black Winter	Picton	S.172	Mean
Total Produce (cwt. per acre)	55.4	57.1	57.0	53.9	44.5	53.6
Grain " "	23.1	23.0	22.4	22.4	19.5	22.1
Straw " "	32.3	34.1	34.6	31.5	25.0	31.5
Percentage of Grain in Total Produce	41.7	40.3	39.3	41.6	43.8	41.25

The variation of the grain/total-produce ratio is so low that, where conditions made it impracticable to thresh plots or samples from them, the yield of total produce would be unlikely to lead to any incorrect conclusions. It would, however, be necessary to allow the sheaves of a plot to dry thoroughly before weighing or to use a sampling method as described above.

Percentage of Kernel in the Complete Grain As already emphasized, the percentage of kernel (or, by subtraction from 100, the percentage of husk) is of considerable importance because of the low feeding value of the husk compared with the kernel. The results for the cleaned grain are given for three years in Table 3.

Table 3

Percentage of Kernel in the Grain
Yearly Averages 1946-48

Year	Trials	Mean	S.147	Grey Winter	Black Winter	Picton	S.172	For Variety Means: Standard Error	For Variety Means: Sig. Dif.
1946	4	76.1	75.7	77.6	75.8	77.4	74.1	.31	.96
1947	4	77.0	76.2	78.0	77.6	77.4	75.6	.20	.63
1948	3	76.1	75.4	76.9	75.5	77.8	74.7	.16	.53
Av. of 11 centres		76.4	75.8	77.5	76.3	77.5	74.8	.15	.43
Order			4	1	3	1	5		

Grey Winter and Picton are close together and slightly better than Black Winter ; S.147 and S. 172 are consistently fourth and fifth. The differences with these winter varieties are, however, less marked than with British oats in general, including spring kinds. Thin-husked samples with a kernel content near the 77–78 per cent level are comparatively infrequent in spring oats, if Scotland is excluded, whereas thick-husked samples, near or even below the 70 per cent level, from varieties such as Onward, Yielder, Supreme, Marvellous and Black Tartarian, are fairly common. In this respect the winter varieties have a marked advantage.

From the point of view of the oat-miller, Picton, S.147 and Grey Winter are well liked, with Picton taking first place, and all three are superior to the spring varieties usually grown in England.

Crude Protein in the Kernel of the Oats After separation from the whole grain, nitrogen determinations were made on the kernel samples. In Table 4, and the discussion which follows, the results have been expressed as crude protein, using the multiplying factor 6.25 as is customary in tables of feedingstuffs analyses.

Table 4

Crude Protein in Kernel

Percentage of Dry Matter

Year	Trials	Mean	S.147	Grey Winter	Black Winter	Picton	S.172	For Variety Means	
								Standard Error	Sig. Dif.
1946	4	13.52	13.3	12.8	13.7	13.4	14.4	.19	.58
1947	4	16.20	17.0	15.1	17.0	15.4	16.6	.28	.88
1948	3	13.84	14.0	13.5	14.2	13.4	14.1	.35	1.13
Av. of 11 trials		14.57	14.75	13.81	15.06	14.13	15.12	.16	0.45
Order			3	5	2	4	1		

Examination of the data at the individual centres (not detailed in Table 4) shows that, in a particular season, there was a big difference between centre averages. Thus, in 1946, at Knebworth, the five varieties averaged 15.5 per cent and at St. Albans 11.8, a difference of 3.7, which is greater than any difference between the yearly means. Clearly many trials would be necessary to justify any conclusions about the effect of seasons.

As regards variety comparisons, on the average of the eleven centres which is very nearly the same as the average of the yearly means, S.172 and Black Winter almost tie for first place with just over 15 per cent of crude protein. Grey Winter is lowest with 13.81 and is not higher than fourth in any season. Black Winter is the most consistent, not taking a lower place than second in the yearly averages. It should, however, be stressed that several factors, particularly winter hardiness and standing power, must decide the choice of variety, and the high position of Black Winter in protein must not be regarded as an over-riding consideration in favour of this variety.

It is a matter of considerable practical and theoretical importance whether a variety of non-leguminous crop can take a leading position both for yield and for protein content. In the case of the winter wheats (1) it was shown that the best, or equal-best, variety for yield was not far behind the highest variety for protein percentage and was at the top for increase in protein content, due to a nitrogen top dressing. If a comparison of a similar kind is made for the winter oats, using Black and Grey, the result can be briefly summarized as follows :

	Yield	×	% Kernel	×	% Protein	=	Protein per acre *cwt.*	*ratio*
Grey Winter	21.79 cwt.		77.5		13.81		2.33	100
Black Winter	21.51 „		76.3		15.06		2.47	106

Grey Winter is only 1.3 per cent better in yield and 1.5 per cent better in kernel content than Black Winter, but the significantly higher protein percentage of the latter variety puts it 6 per cent ahead in the total production of protein per acre. The result suggests that a high yield is not necessarily incompatible with high protein, and support for this tentative conclusion, which agrees with the winter wheat, will be given later from a replicated trial in which S.172 came first for yield—and that a high one for the district.

Effect of Spring Top Dressings of Nitrogen on Winter Oats Unlike winter wheat, winter oats are seldom top dressed with nitrogen fertilizers in the spring, chiefly because Grey Winter, the most hardy variety, is of poor standing power and the dressing would tend to enhance this weakness. As S.172 has short, strong straw, its response to top dressings is of some importance and a small number of experiments, four in all, have been carried out with it, side-by-side with the older varieties.

At one centre in 1949 the varieties were not replicated but, as sections of each strip were selected at random for the top dressings, their effects can be tested for significance. In the other three experiments the varieties were duplicated in randomized blocks, and as each of the strips was subdivided for nitrogen there was a fairly high degree of replication for its main effects.

1947 Experiment The experiment in 1947 was carried out on a medium loam near St. Albans on the Institute farm. The varieties survived the severe 1946–47 winter well and the top dressing of 2 cwt. per acre of "Nitro-Chalk" was not applied until May 19. As the variety comparisons have already been included in Tables 1–4, only the average effects of nitrogen are shown in Table 5.

Table 5

Effect of May top dressing of 2 cwt. "Nitro-Chalk" per acre
Average results for five varieties, 1947

		No N	N	N effect	Sig. Dif.
Yield Cwt. per acre	Grain	21.51	23.88	2.37	2.8
	Straw	25.1	29.6	4.1	
Percentage kernel in grain		77.1	77.8	0.7	0.51
Percentage crude protein in kernel ..		14.94	16.44	1.5	0.36

In spite of the date of applying the nitrogen, which might have been too late for a maximum result, the actual response in yield was the reasonable one of 2.37 cwt. of grain (87 per cent dry matter content) and 4.1 cwt. of straw (corrected to threshing time, not harvesting weight), though these are below the 5 per cent level of significance. There was a small but statistically significant rise of 0.7 in the percentage of kernel in the grain, and a highly significant increase of 1.5 in the crude protein content of the kernel.

Experiments in 1949 and 1950 In 1949 experiments were started on winter wheat, winter oats and spring oats to ascertain the effects of late-applied nitrogen on the protein content, as earlier results with wheat had suggested that they might well be large enough to be of practical importance. In the experiments summarized in Table 6, the variety strips were subdivided into three, one section (No nitrogen) remaining as control, another section (N2) receiving 2 cwt. "Nitro-Chalk" in mid-April, and the third section (N4), receiving the April dressing, *plus* an equal one in mid-June. All plots and sub-plots were randomized, and all

dressings were applied by hand. Harvesting was by combine and the yields of each plot were corrected to a uniform moisture content of 13 per cent.

In section (a) of Table 6, where varieties are being compared, three sub-plots are put together for Centre T and six for A and O. In section (b), where the nitrogen plots are compared, each figure for Centre A is the average of eight sub-plots, for Centre T of six and for Centre O of twelve.

At Centre T in 1949 the plots were not sown until February and at one time looked so poor that ploughing up was considered. The yield, however, was up to average, with Unique (included for the first time in these trials) taking the leading position. In percentage of kernel, Unique was a trifle below S.172, but in percentage of protein it reached the exceptionally high figure of 18.3 (average of the three levels of nitrogen). In the only other trial in which Unique has been included (Centre O in 1949, where the high average yield of 32.2 cwt. was recorded) this variety was up to the average in yield and was again top for crude protein (16.9 per cent)—significantly higher than other varieties except Black Winter. This confirms the point made earlier that high protein is not necessarily incompatible with high yield. S.172 at the same centre supports this too, since it was top for yield and third for protein.

Table 6

Variety Yields and the Effects of Early and of Early plus Late Applications of Nitrogen in Three Trials with Winter Oats

(a) COMPARISON OF VARIETIES (N SUB-PLOTS COMBINED AND AVERAGED)

	Mean	S.147	Grey Winter	Black Winter	Picton	S.172	Unique	Sig. Dif.	Remarks
				Yield of Grain (cwt. per acre)					
1949 Centre A	28.4	28.4	29.05	—	28.75	27.5	—	7.9	Only 4 varieties
1949 Centre T	21.6	22.0	22.4	19.1	20.5	22.5	22.8	—	Varieties not replicated
1950 Centre O	32.2	31.6	33.05	30.15	32.35	33.9	32.25	2.15	
				Percentage of Kernel in Complete Grain					
1949 Centre A	75.7	75.8	76.0	—	76.5	74.3	—	0.74	Only 4 varieties
1949 Centre T	75.9	75.7	76.3	76.5	77.0	74.9	74.7	—	Varieties not replicated
1950 Centre O	75.0	75.2	76.1	74.7	76.2	73.6	74.5	0.62	
				Percentage of Protein in Kernel					
1949 Centre A	12.4	12.0	12.1	—	12.3	13.2	—	0.19	Only 4 varieties
1949 Centre T	17.3	16.9	16.4	17.8	16.9	17.6	18.3	—	Varieties not replicated
1950 Centre O	15.2	14.6	13.9	16.6	13.9	15.1	16.9	0.60	

Continued overleaf

(b) Comparison of Nitrogen Effects (Averaged for Varieties)

Centre	*Yield of Grain (cwt. per acre)*				*Percentage of Kernel in Complete Grain*			
	No N	N2	N4	Sig.Dif.	No N	N2	N4	Sig.Dif.
A	23.65	30.15	31.45	0.88	76.1	75.4	75.6	0.34
T	20.9	21.65	22.3	2.7	76.2	75.5	75.9	0.60
O	31.2	32.2	33.3	1.8	74.7	74.8	75.6	0.40

Percentage of Crude Protein in Kernel

	No N	N2	N4	Sig. Dif.
A ..	11.65	12.45	13.15	0.25
T ..	16.4	17.45	18.15	0.545
O ..	13.8	15.1	16.6	0.61
Average ..	13.95	15.0	15.95	

The figures for percentage of kernel in the grain agree with those of the earlier trials in showing the relative unimportance of this factor for these varieties. Combining the results of the three experiments with those on which Table 3 is based, the averages for the four varieties included in all fourteen trials become :

	S.147	Grey Winter	Picton	S.172	Mean
Percentage of kernel ..	75.8	77.2	77.3	74.7	76.25

The centre averages for 1949 of the protein in the kernel provide another illustration of the great spread that may occur in a season between places not far apart, in this case only fifteen miles. At A, the average was 12.4 per cent, at T 17.3, and the difference (4.9) was no less than 40 per cent of the figure at the lower centre. Even this was less than the difference between A and some small experimental plots at the Cereals Research Station only two miles away, where the five winter varieties averaged 18.8 per cent of protein over the three years 1947–49.

Other work on oats (Hutchinson and Martin, unpublished) shows that each centre is associated with a crude protein level around which the varieties group themselves with a divergence from it of about the same amount at a high centre as at a low. Certain types of land often give high protein oats even without a top dressing, but such grain is frequently of poor quality for milling or feeding, owing to the presence of many empty or poorly filled grains.

Considering next the effect of the nitrogen dressings, the mid-April application gave the large increase of 6.5 cwt. at A, but only 0.75 cwt. at T and 1 cwt. at O. Such a small number of trials does not justify a conclusion being drawn regarding an average effect, but it so happens that the mean of the three responses is the reasonable one of 2.7 cwt. extra grain. (In the wheat trials, on the average of nineteen centres, the response to the same dressing was 3.66 cwt.) The additional mid-June dressing also raised the yield to a small extent which was significant at A ; the average effect was 1.0 cwt. It is clear that nitrogen can sometimes influence yield at this late date of application.

Small but significant effects of nitrogen on the percentage of kernel in the grain were obtained, but the direction varied. At A and T it was down ; at O it was up, as in the 1947 experiment. On the average, the effect was exactly nil and probably is of no practical importance.

The increases in crude protein content of the kernel are among the most interesting results of the experiments ; at each of these three centres the

nitrogen raised the percentage of protein. This was true for the average of the varieties and also for each strip of each variety. The average increases were :

	N2–No N	N4–N2	Total Increase
Centre A	0.8	0.7	1.5
Centre T	1.05	0.7	1.75
Centre O	1.3	1.5	2.8
1947 Experiment ..	1.5	—	—

Omitting the 1947 experiment, when the nitrogen was applied at an intermediate date, the average response to the mid-April dressing was 1.05 and to the mid-June dressing 0.95. These increases are not spectacular but they are important, as each is about 7 per cent of the protein of the no-nitrogen plots. The number of trials is obviously too small to draw any conclusions regarding the variations of the increases from centre to centre, but one further result shown by detailed examination of the figures used to compile Table 6 is that the variety S.172, which had been highest for protein in pre-1949 trials, gave a larger response to the nitrogen dressings than Grey Winter, which was lowest for protein. This finding is in agreement with the result recorded for winter wheat.

Oil Content of the Kernel A brief summary of the amount of oil extracted from the kernel by petroleum ether is given in Table 7, which also includes figures for Marvellous, a variety sometimes used as a semi-hardy winter oat, and for two well-known spring varieties, Victory and Black Supreme. Each figure is the average of numerous analyses.

Table 7

Percentage of Oil in the Dry Kernel

Grey Winter	9.8	Unique	9.0
S.172	9.5	S.147	7.6
Black Winter	9.2	Marvellous	7.0
Picton	9.2	Victory	6.9
Black Supreme	6.0		

Five of the six winter varieties averaged 9 per cent or over, but S.147 averaged only 7.6. That the high oil content of the five varieties is not caused by environment or winter habit is shown by the low figure for S.147 ; further, a few varieties are found amongst spring oats with oil nearly as high as Grey Winter. The high values for the newer varieties, Picton, Unique and S.172, are probably a varietal characteristic inherited from their Grey Winter parent, but, if so, its loss in S.147, but not in S.172, is particularly interesting.

Other work (Hutchinson and Martin, awaiting publication) shows that the oil content of the kernel of British varieties of oats varies from 4.5 to 11.0 per cent. To each true variety a mean level can be assigned, about which there is a range of 1.0 per cent caused by season or environment, particularly soil. Samples of the four varieties, Grey Winter, S.172, Picton and S.147, grown side by side at trial centres throughout England over four seasons, have been provided by the Director of the National Institute of Agricultural Botany. Their analyses show variations in oil content very little greater than those found in the Hertfordshire trials.

Summary The four varieties, S.147, Grey Winter, Black Winter and Picton, in fourteen trials over four seasons, averaged 21.75 cwt. of grain per acre, none of the four differing by more than 0.6 from this average.

S.172 averaged 18.99 cwt., a significantly lower yield. In a small number of later trials S.172 has, however, given high yields on mineral soils of medium texture.

Grain has averaged 40 per cent and straw 60 per cent of the total produce.

The difference in the percentage of kernel in the grain between these varieties has been small ; Grey Winter and Picton were highest with 77.5 and S.172 lowest with 74.8.

In crude protein content of the kernel, S.172 and Black Winter were highest with about 15 per cent and Grey Winter lowest with 13.8.

It is shown that high protein is not necessarily incompatible with high yield. There have been striking differences between the average protein percentages of centres in the same season, even when not far apart ; for one pair of centres the difference was 4.9.

A few trials with spring top dressings of nitrogen have given greatly varying responses in yield and the number of trials does not justify quoting an average effect. In these trials the mid-April dressing of 2 cwt. "Nitro-Chalk" per acre has significantly increased the percentage protein in the kernel by 1.05 and an equal additional dressing in mid-June has given a further significant increase of 0.95.

By a choice of variety and application of medium-late and late top dressings it may be possible to raise the percentage of protein by 3. If the reason for high protein centres could be elucidated, an even greater additional increase might become possible.

S.147, with 7.6 per cent of oil in the kernel, was well below the other winter varieties, which averaged 9.3.

Very grateful acknowledgment is made of the help given by a colleague, H. F. Martin, whose work has provided much of the data included in the tables. The analytical figures used here are only part of a much more comprehensive investigation on the chemical composition of oats, of which a full account will be published elsewhere.

References

1. The Effect of Nitrogen Top Dressings on the Yield of Winter Wheat. H. W. GARDNER. *Agriculture*, 1950, **57**, 1-8.
2. The Effect of Nitrogen Top Dressings on the Quality of Winter Wheat. E. N. GREEN and N. L. KENT. Ibid., 59-63.
3. The Standard Errors of Field Plots at Rothamsted and Outside Centres. H. V. GARNER and J. W. WEIL. *Emp.J. exp. Agric.*, 1939, **7**, 369-79.

FAT LAMB PRODUCTION ON A BRECONSHIRE FARM

H. EDMUNDS, B.SC.

County Agricultural Officer, Breconshire

Less is heard of the intensive keeping of sheep than of such systems practised with other forms of livestock. This article shows how Mr. Watts of Cwmwysg Isaf, Sennybridge, has improved the output of fat lambs and ewes on his 86-acre farm, and suggests the possibilities of second-class land adding an increased quota of meat to help the country's need.

IN a county such as Breconshire, where approximately two out of every three acres are rough grazings and only some 6 per cent of the land lies below the 500 feet contour, the sale of sheep inevitably figures largely in farm incomes. In the past on almost all farms the associated form of livestock was beef stores. For various reasons, milk production was relatively slow in developing within the county, with the result that at the present time two-thirds of the farmers are still rearers of beef stores and many of the others, although milk sellers, use Hereford bulls for producing colour-marked crossbreds. On the other hand, while dairy cows have to some extent replaced the traditional beef cows, their influence on the keeping of lowland ewe flocks has been negligible.

A comparison of the problems of management between hill and lowland flocks reveals that basically the difference is one of the degree of control that man can exercise. Herbage productivity on open hill areas is still very largely outside human influence, but due recognition should be given to possible developments over such areas, now that aerial top dressing has been proved to be technically feasible. Influence over climatic factors remains unchanged. Productivity in hill flocks is therefore mainly governed by the vagaries of nature. But considering the opportunities for management that arise with our enclosed grassland areas, linked with the use of leafy productive grasses and clovers, the availability of appropriate fertilizers and a rapidly expanding knowledge of sheep diseases, it would seem that the prospects for an increased output of mutton and lamb are improving markedly.

The necessity for greater supplies of mutton and lamb needs no emphasis, and the extent to which lowland sheep farmers have progressed in utilizing the wealth of scientific information at their disposal is of national importance. A survey of textbooks relating to sheep husbandry and of the publications issued by research stations, both home and abroad, indicates that in scientific circles sheep matters have received their due amount of attention. Dr. Allan Fraser (1) lists over two hundred references, all of which he quotes as having a bearing on the various aspects he discusses. An equally impressive array of references can be secured on sheep diseases, many of which are now controllable.

There are plenty of farmers practising modern techniques with dairy cattle, pigs and poultry, but few producers of mutton and lamb show a corresponding intensity of production deriving from the work of agricultural scientists and others. The achievements of producers of milk, pigs and poultry have, during the past ten years, been widely publicized in the press, from the platform, at large and small demonstrations, by films, radio and in other ways. Corresponding publicity is seldom given to those farmers who have evolved a line of management designed to make the most of the productivity of

lowland grass sheep. The activities of Mr. D. P. Watts of Cwmwysg Isaf, Sennybridge, a small Breconshire farmer with a high output of fat lambs, furnish a case in point.

The Holding Mr. Watts succeeded his father in the occupation of an 86-acre holding, ranging from 600 to 800 feet above sea level, and which might be described as an improved marginal farm. His main objective is the production of as many fat lambs off grass as possible. The cultivated area amounts to 73 acres, all of which is ploughable ; in addition there are 13 acres of felled and standing woodlands. With the exception of a 4-acre home field, the whole area is worked on a ley system. Leys remain down for three to five years, depending upon their quality. Every year since 1945, 22 acres or so have been under tillage crops, made up of approximately 16 acres oats and barley and 6 acres swedes, mangolds, rape and potatoes. The latter is the only cash crop. No regular labour is employed ; casual assistance for root singling is becoming more difficult, and shearing is still a matter of arrangement between neighbours.

The stock on the holding over the last few years has been as follows :

	1945	1949	1950
Cattle			
Cows and heifers in milk or in calf	6	8	9
Other cattle	9	11	14
Total Cattle ..	15	19	23
Sheep			
Ewes	70	100	106
Lambs	80	140	148
Rams	2	3	3
Total Sheep ..	152	243	257

The cows are Shorthorn × Hereford and kept for breeding and suckling of calves, which are sired by a Hereford bull.

In 1945 a tractor replaced the two or three horses which, until then, were used for cultivations, etc. Their absence has been a contributing factor to the increase in stock since then.

The prevailing hill breed of sheep of the district is Welsh × Cheviot, and for some years this cross alone has been kept. About 30–35 young draft hill ewes are bought annually at the local sales in late September, and normally they produce another two to three crops of lambs before being finally graded. They were bought in the autumn of 1949 at £5 a head. In an area where all farmers keep sheep, and peace and goodwill between neighbours must be maintained, the choice of breed is a matter of no small importance. Even milk has to be sacrificed to this consideration, a fact which may account for the infusion of Cheviot blood into this otherwise all-Welsh locality.

The favoured breed of ram is the Suffolk, but last season a Dorset Down was very successful in producing quick-fattening lambs for early sale. Lambs by the Suffolk and Shropshire rams are considered to be better fitted for midseason and early autumn selling.

High birth-rates are materially influenced by flushing the dams and fresh swards are set aside to ensure a steadily rising body condition prior to mating. Infertility in rams, particularly newly-bought ram lambs, is probably more common than is admitted, and to minimize this risk it has been the practice

in the last four or five years to split the flock into groups. Thus, in 1949, 45 ewes were run with the Dorset, 45 with the Suffolk, and the remaining 20 with an older Shropshire tup. After a fortnight the Dorset and Suffolk replaced each other, and in the early weeks of November the whole flock with the three rams became one unit. The absence of "empty" ewes in recent years is attributed in no small measure to this practice.

The date of beginning supplementary feeding depends very largely on the weather during the winter. Under normal conditions hay is not usually provided before the end of the year. During the last four to six weeks of pregnancy, the level of nutrition is raised by folding the flock over a crop of swedes. Farming opinion holds that good feeding during this time exercises a profound influence both on the size and vigour of the lambs, as well as on the subsequent milk yield of the mothers. The accuracy of this opinion has been substantiated by fairly recent experimental work at Cambridge and elsewhere. At present it is a matter of conjecture whether the feeding of swedes on the field is detrimental to sheep's teeth and consequently to the duration of their breeding life. Mr. Watts is inclined to agree with this theory, and partly for this reason and partly to reduce work attached to singling and cleaning of swedes, thousandhead kale will be tried next winter.

Swedes are replaced by mangolds immediately lambing begins, and in normal seasons the supply of the latter is sufficient to last until about the second week in April. During the succeeding months ewes and lambs are fed wholly on grass.

During the early weeks of life, lambs are entirely dependent on milk for their development. Information in respect of the milking capacity of British breeds of sheep is scanty, but Wallace ([2]) working at Cambridge throws considerable light on the matter. He states :

> Milk yields were recorded during the 1942 season with Suffolk ewes for fourteen complete lactations of 20 weeks, and during the 1943 and 1944 seasons with Border Leicester × Cheviot ewes for twenty-two complete lactations of 16 weeks. Milk yields in each lot reached their maximum during the second and third weeks and fell steadily thereafter. Approximately 38 per cent of the total yield for the 16 weeks period is produced in the first month and about 30 and 21 per cent in the second and third month respectively, and only about 11 per cent in the last month.

Assuming that other breeds of sheep, and in particular Welsh × Cheviot ewes, show the same lactation curve, it is clear from Wallace's work that if lambs are to fatten quickly, grass of quality and quantity must be available from the time when they begin to eat—about 6 weeks old—in order to supplement the dwindling milk yields.

The Problem Period Under conditions of less intensive sheep husbandry, that is, when sheep are thin on the land, seasonal herbage growth is normally adequate to avoid any sharp decline in the total milk/grass requirements. On Cwmwysg, however, or on any other farm where a similar type of husbandry is practised intensively, the supply in fact becomes limited by closing an area for hay. A "problem" period, therefore, starts from the time lambs begin to graze and lasts until the beginning either of hay harvesting or marketing, whichever is first.

The relationship between stock and grass acreage in 1950 for this difficult period is given below :

1.	mid-April to mid May	51 acres	257 sheep and 23 cattle
2.	mid-May to mid-June	41 ,,	257 ,, ,, 23 ,,

The second half is more critical than the first, due to the smaller area of grazing, which is expected to support the same number of animals with, in the aggregate, greater herbage needs.

Before considering the specific effect of the shortage of grass, it is appropriate at this stage to refer to Hammond's work (3) dealing with the factors which are involved in early maturity in sheep. Whereas in late-maturing breeds, the three-growth stages of (a) body framework, (b) muscle or lean meat and (c) fat, develop more or less in succession, in the early-maturing breeds the three stages proceed simultaneously, provided a high plane of nutrition is possible. Therefore any lowering of the level of nutrition (e.g.. grass shortage), even though it may be temporary, would result in lambs passing through a period when fat is being formed only slowly.

Before the war, imported concentrates offered an easy and convenient means of making good any diet deficiency ; under present-day circumstances, the solution appears to be in the maintenance of adequate nutritious grass or some other crop, skilfully managed in order to achieve maximum utilization.

An indirect approach to the problem, by way of a change in the cattle management in recent years, has considerably eased the position on Cwmwysg. Instead of following the prevailing local custom of selling his store cattle in the autumn at 18 months old, Mr. Watts feeds his weaned calves in their first winter very well and then sells them in the spring as yearlings.

The first method of direct approach obviously lies in growing more grass, and those leys that are considered to be the most productive are top dressed with 2 cwt. per acre of nitrogenous fertilizer in late March. In earlier years a smaller application was given, but the additional herbage produced was relatively small. Deficiencies in lime, phosphates and potash are made good whenever they occur.

Apart from the question of manuring, the nature of the seeds mixture may play a more important part than can be actually assessed. For some years, a 35-lb. per acre mixture has been used, composed of slightly more than half commercial perennial ryegrasses, equal proportions of S. strains of perennial ryegrass and cocksfoot, and the normal amounts of indigenous white clover. A rather unusual feature is the practice of supplementing this mixture with 4 lb. Montgomery red and 1 lb. S.123 red clover. Bearing in mind the fact that in an average season commercial ryegrasses begin to throw up flowering stems round about the second week in May, the inclusion of the late red clovers might be expected to provide leafy herbage when the early ryegrasses are entering a period of temporarily declining productivity. By some modern standards, the seed rate might be considered high, and the mixture deficient in the indigenous strains of grasses. Critical evidence on either of these two points or on specialized mixtures suitable for intensive grazing by sheep is, however, scanty.

With regard to management, Mr. Watts has noticed that strong, single lambs develop more rapidly than twins or weakly singles, and to accelerate their growth it is his practice to select 15–20 of the best and graze them with their mothers in front of the main flock. Such preferential treatment usually results in the first lot of lambs being fit for slaughter about the second or third week of June. In June, 1950, a bunch of 12 was graded on June 14 at an average estimated dead weight of 49 lb. and, at the then prevailing price, each realized nearly £6. It was not possible to ascertain the exact age of this consignment, but the interval between the birth of the first lamb on March 6 and the date of sale was 14 weeks, 2 days.

In order that the pastures shall not become stale, the lambs are moved from field to field every two or three days, despite the fact that the next field may be poorer and less productive than the last. Freshness of diet is considered always to be highly beneficial. This aspect of management is made possible by the relatively small size of the fields, each of which is made stock proof by well laid hedges.

Although hand-milking of sheep immediately after the sale of early lambs plays no part in Mr. Watts' activities, it is of historical interest to record that this very old custom still exists on several Breconshire farms. Cheese is the end product.

Disease Precautions An account of any sheep enterprise would be incomplete without mention of the disease problem, particularly on a farm where sheep have always been kept, latterly in increasing numbers. Attacks of sheep maggot fly are kept under control by DDT dips. A single dipping of the lambs in the first week of June is found to give adequate protection. The regulation dipping comes later in the season.

Worm infestation in the lambs is controlled by monthly dosing with phenothiazine in May, June and July. In earlier years losses at lambing time were fairly serious, but on the advice of the local veterinary practitioner, the regular use of the appropriate vaccine eliminated the wastage brought about by post-parturient gangrene, locally known as blackleg or inflamation. All ewes are now injected about a month before lambing.

Foot rot in recent years has increased, but the provision in the near future of a footbath, followed by regular treatment with copper sulphate, should mitigate the setbacks experienced from this particular complaint.

Sales 1950 The full expression of all the facets of a successful enterprise reveals itself in the quality and quantity of the products sold off the farm. Between June 14 and October 25, 1950, 148 lambs were graded from 106 ewes at an average estimated dead weight of 41 lb. per lamb ; during the same period 33 fat ewes were graded at an average estimated dead weight of 53 lb. a head.

Fat Lamb Sales, 1950

	June		July	Aug.	Sept.	Oct.		Total
	14	28	26	9	6	4	25	
Lambs (No.)	12	20	30	30	16	18	22	148
Est. dead weight (*lb.*) ..	49	40½	41	41	45	43	33	6,078
Ewes (No.)	6	4	4	6	8	5	—	33
Est. dead weight (*lb.*) ..	54	56	55	53	48	56	—	1,750

Wilkinson (4), working at Cambridge with pure Welsh ewes, was able to rear 154 lambs per 100 ewes ; the ewes when fat averaged 49½ lb. dead weight.

A recent official announcement states that as from January, 1952, a bonus of 6d. a pound will be paid between January 1 and the end of June for spring lambs which are estimated to be not more than 16 weeks old and to yield first-quality carcasses of not less than 26 lb. This is a sufficiently attractive incentive to seek ways and means, other than those already described, of

easing the stock/grass relationship, if the benefit of the bonus is to be secured. The first and most obvious would be to remove the cause of the problem period by utilizing for grazing the 10 acres now kept for hay. The equivalent amount of winter fodder could, at least theoretically, be obtained if late summer or autumn grass were ensiled. At this time of the season, when sales of stock are virtually completed, grass is normally plentiful.

A second and perhaps more attractive modification would be to grow additional crops. Thus the provision of swedes or kale for late winter feeding by in-lamb ewes does not necessitate sowing much before the end of June. Normally, cereals of one kind or another are the preceding crop, and the inclusion of 15 lb. or so per acre of Italian ryegrass with the grain, would supply a small but useful additional bite in the late spring prior to ploughing the field for the root crop. In much the same way, rye sown in September can be heavily grazed up to the time the land is needed again.

Although the various modifications already discussed would have the effect of increasing the fodder supply in relation to the stock carried, it is not considered that they would close the gap entirely. It may well be that a better technique of grazing could be devised comparable with that now in existence on dairy farms, where the use of the electric fence has resulted in a better utilization of grass to the extent of 20–30 per cent. As far as the writer is aware, there is very little information available of any technique, whatever form it may take, where corresponding results have been obtained with sheep.

A revival of interest in sheep might reasonably be expected in the future, if only as a result of such factors as higher wool prices, the special bonus for early fat lambs and the Livestock Rearing Act. An attempt has been made to show how some of these benefits might be secured. There are doubtless many other flocks where productivity and output are higher, but, set against the background of the size and nature of the farm and the economy in the use of labour, and with a flock composed of hill ewes, the effort indicates that there is every possibility of augmenting the national supply of meat, even from second-class land.

References

1. ALLAN FRASER. *Sheep Husbandry.*
2. The Growth of Lambs before and after Birth in Relation to the Level of Nutrition. L. R. WALLACE. *J. agric. Sci.*, **38**, Pt. 2, 7–153.
3. J. HAMMOND. *Growth and Development of Mutton Qualities in the Sheep.*
4. Welsh Mountain Ewes as a Source of Grassland Breeding Ewes. J. H. S. WILKINSON. *J. R. agric. Soc.*, 1949, **110**, 76–88.

PEA GROWING IN HOLLAND AND BELGIUM

2. RESEARCH AND ADVISORY WORK

J. D. REYNOLDS, N.D.A., C.D.A. (Hons.)
Home Grown Threshed Peas Joint Committee

In this concluding article, Mr. Reynolds records his impressions gained from a visit in 1950 to study the pea-growing industry of the Low Countries. The first article, dealing with general husbandry, appeared in the June issue of this JOURNAL.

AMONG the Dutch agricultural research institutes and allied organizations, most of which are established at Wageningen in the centre of the country, one of the most important is the autonomous Central Institute for Agricultural Research (C.I.L.O.), which comprises a large number of departments dealing with a wide range of problems connected with various crops. The pea crop is receiving attention by the departments established for legumes and maize, weed control, and human nutrition. In this building is also the office of the Government agricultural adviser for pulse crops, who is also associated with the Pod Vegetable Study Group (P.S.C.), an organization analogous to the Home Grown Threshed Peas Joint Committee, although it is concerned with other pulse crops besides peas. The P.S.C. secures the co-operation of the appropriate departments of C.I.L.O. and other research institutes in carrying out investigations relating to pulse crops. At present, work on peas includes field experiments dealing with chemical weed control, the influence of various row widths and seed rates on the yielding capacity of different varieties, and date of sowing.

At the human nutrition laboratory, research is being carried out on the analysis of different pea varieties and the factors influencing their cooking and canning qualities. It has been found that the presence of adequate phosphorus is essential for satisfactory cooking, but beyond a certain level it has the opposite effect. It has also been established that cooking quality is related to time of fertilizer application, a dressing the preceding autumn giving better results than a spring application. The effect of phosphorus on the cooking properties of peas has been found to be still further enhanced by the presence of adequate potash. High protein content appears to be invariably correlated with high phosphate.

Most of the research work on peas in Belgium is at present confined to vining peas and is undertaken by the Ministry of Agriculture's Station for Research on the Improvement of Orchard, Small Fruit and Market-garden Crops at Gembloux, which is mainly concerned with the breeding and selection of improved varieties, and by the National Institute for the Improvement of Vegetables for Preservation, known as INACOL, near Brussels. The latter organization came into existence at the end of the second world war, by the sponsorship and financial support of the larger canning firms, which together handle 80–90 per cent of the total production of canned vegetables. It is concerned with both cultural and canning research problems and particularly with the question of variety improvement. On the cultural side, field trials in the principal agricultural regions of the country dealing with such aspects as the possible tainting of vining peas by benzene hexachloride (BHC) applied for wireworm control, chemical weed control, trace element deficiencies on the *Campine* soils, seed disinfectants, etc., are being carried out.

Improvement of Varieties Improvement of varieties of vining peas, both from the cultural and canning quality viewpoints, is being achieved in conjunction with the research station at Gembloux, by : (1) the introduction of promising foreign varieties, (2) the improvement of established varieties by selection, and (3) hybridization.

Some hundreds of different strains from many home and foreign sources are tested annually. The kind of pea which they are striving to produce in Belgium is a type with stiff straw of medium length, bearing small, round, sweet peas. At the present time there is no legislation in Belgium for the protection of plant breeders' material and no field approval or certification scheme for peas. Of threshed peas, few crops are in fact reserved for seed purposes, most of the seed requirements being imported annually.

The position is very different in Holland. Here a scheme of variety improvement and maintenance of purity has been developed over many years. There are a number of private plant breeding stations, of which three have made particularly valuable contributions as far as peas are concerned. Under the Plant Breeders' Decree of 1944, the breeder is given legal protection for his varieties introduced, and is entitled to receive annual royalty payments in respect of the quantities sown. The Institute for Plant Breeding, besides being concerned with the breeding of new crop varieties, also supplies private breeders with new plant populations, gives advice on genetical matters and tests breeders' new varieties. It is an autonomous organization and closely integrated with the N.A.K. (Netherlands General Inspection Service for the Seeds of Field Crops and Seed Potatoes), and I.V.R.O. (Government Institute for Research on Varieties of Field Crops) in regard to the introduction and testing of new varieties. The N.A.K., besides being responsible for the field- and sample-approval of crops and the sealing of the bags of seed, also administers the system of royalty payments to breeders through the Plant Breeders' Compensation Funds.

Many new strains of vining peas, including a number from abroad, are being grown in Holland on small-scale observation plots, as in Belgium, to ascertain whether any of them have outstanding characteristics in comparison with established varieties.

Research on Diseases The most common diseases that occur in the Low Countries are caused by *Ascochyta* sp. and related organisms, and by *Fusarium* sp., the latter causing root and foot rots, and wilt disorders. In Holland Fusarium diseases are of considerable economic importance, and on the so-called " Western Clay " soils (sea silt) where they are widespread, pea varieties bred for resistance to *F. solani*, namely, Rondo, Stijfstro and Parel, are largely sown. Certain organisms which cause vascular diseases, known in the U.S.A. as Fusarium wilt (*F. oxysporum* f. *pisi* race 1*), and Near-wilt (*F. oxysporum* f. *pisi* race 2) have also been identified in Holland. The name St. John's disease is often used to describe many cases of wilting, because symptoms of attack become very pronounced about St. John's Day (June 24). It is now recognized, however, that this condition is often due to the pea root eelworm (*Heterodera goettingiana*), to which none of the present varieties is resistant.

None of the varieties at present on the Dutch " Descriptive List of Approved varieties of Field Crops " is resistant to the Fusarium wilt diseases, but research is in progress to assess the degree of resistance of different pea

*Synonymous with *F. orthoceras*, var. *pisi*.

varieties to a form of Near-wilt, which is becoming increasingly important in Holland. Experiments have been conducted recently at the Phytopathological Laboratory, Wageningen, using the same procedure described by Wells *et al.** in the U.S.A., in which the American vining pea varieties Delwiche Commando (resistant to Fusarium wilt and Near-wilt) and Wisconsin Perfection (resistant to Fusarium wilt but susceptible to Near-wilt) were tested in comparison with certain Dutch varieties. Plants were inoculated with both the American and Dutch strains of the Near-wilt fungus. Since none of the varieties tested was killed by the Dutch strain, and the Dutch varieties succumbed to the American strain, it appears that the two strains are distinct, because some varieties susceptible to the American strain seem to be resistant to the Dutch strain, and vice-versa. This Dutch strain has been designated *Fusarium oxysporum* f. *pisi* race X.

Investigations are also in progress in Holland to attempt to establish the influence of soil structure and temperature on the incidence of *Fusarium solani*. Work is also being done on the effect of fungicides based on quinone derivatives and the thiocarbamate group of compounds in preventing damage by *F. solani*, *Pythium* sp. and *Botrytis* sp.

Advisory Services The agricultural advisory services in Holland and Belgium operate on a regional basis, as in this country. In Holland the service appears to be particularly efficient, for all farmers, both large and small, appear to be kept up-to-date as new information becomes available and improved methods are developed. Problems are dealt with on the spot by a local adviser who, if necessary, refers the matter to the regional headquarters. Government advisers have been appointed to deal with the different classes of crops and spend much of their time visiting farms to deal with the more difficult problems. A chain of experimental farms has been established to cover all the important regions and soil types. These farms are run by the Government, often in conjunction with growers in the locality concerned, and their purpose is to experiment with new varieties, farming systems and methods, so that if results are encouraging and applicable to the areas concerned they can be passed on to the farmers.

Institutes, chiefly located at Wageningen, have been established to deal with the farmers' more complex problems. For example, the Phytopathological Service, besides being engaged on research, also examines plant specimens, etc., submitted on behalf of farmers to identify disorders and advise on remedial measures.

*Evolution of Resistance and Susceptibility in Garden Pea to Near-wilt in the Greenhouse. D. G. WELLS, W. W. HARE and J. C. WALKER. *Phtopath*, 1949, **34**, 771-9.

THE NEW FOREST PASTORAL DEVELOPMENT SCHEME

DAVID R. BROWNING, N.D.A., N.D.D.

Assistant County Agricultural Officer, Hampshire

Under the exigencies of the war certain areas of the New Forest, totalling some 1,000 acres, were taken over by the Hampshire Agricultural Executive Committee for development. Some were resown to grass and others were put under arable crops such as wheat, oats and linseed. The story of this unique effort is told in the following article.

"A POORER spot than the New Forest there is not in all England, nor I believe in the whole world. . . . Still, it is so large, it is of such great extent . . . that it must contain some good spots of land." So wrote Cobbett in the early nineteenth century, and his conviction was also the conviction of those who, in 1940, turned their attention to the large tracts of open heath or unenclosed Forest. In their natural state they seemed to hold out little prospect of adding much to Britain's war-time rations, but there were the odd areas of bracken-covered, gorse-infested grazings, which might, it was thought, be made to yield more food for the benefit of the nation in general and the New Forest Commoners in particular. Thus was born the New Forest Pastoral Development Scheme under the direction of the Hampshire War Agricultural Executive Committee.

The New Forest area is 92,365 acres, made up of 27,658 acres of private property and 64,707 acres of common lands ; of the latter, 39,946 acres are open heath.* In return for payment of a marking fee, the holders of common rights are entitled to turn cattle and ponies on to any part of the open heath at all times, and pigs for a limited period coinciding with the acorn and beech mast season. The rule of "levancy and couchancy" (which is apparently not now enforced) limits the number of stock so turned out (or de-pastured) on the open Forest to the number for which the holding itself can provide accommodation and feed during the winter.†

The Forest and the Commoner The local agents of the Crown are the Forestry Commission, and no enclosure, cultivation or any disturbance of the land surface can be carried out without its permission. The New Forest is peculiar, too, in possessing another official authority—the Court of Verderers—whose duty it is to protect the rights and privileges of the commoners. The Commoners also have their own organization—the New Forest Commoners' Defence Association.

Many farms within and around the Forest possess "Forest rights," and in the sale of agricultural property in this area it is well known that a holding to which such rights are attached will, acre for acre and all other things being equal, sell at a higher figure than one without them.

It will be obvious that any proposal to tamper with the Commoners' rights, however well intentioned, was not likely to be received without considerable reserve, and efforts to point out that the proposal would ultimately benefit them often raised greater suspicion. It must be here

* Report of New Forest Committee 1947. H.M. Stationery Office, 3s. 6d.

† Sheep grazing rights are still held by a few farmers in the Beaulieu area of the Forest but are not now exercised.

recorded, however, that under the stress of war-time conditions the Commoners agreed that attempts should be made to improve the Forest grazings and, later, that even enclosure and denial of their rights for five-year periods was also accepted.

So it came about that in 1941 a start was made on the rejuvenation of the grazings, a start which, however, proved disappointing but provided invaluable experience (as failures always do) to those immediately concerned, and moreover showed unmistakably that attempts at improvement without first enclosing would merely end in third-class results.

Briefly, the first attempt consisted of ploughing selected areas with either a disc plough or a prairie buster, followed by polydisc, a light dressing of lime, a light dressing of fertilizers and a broadcast seeds mixture which was a compromise between the well-known Aberystwyth mixture and the more unconventional " barn sweepings". This was followed by a final working down—all done on the open forest without an enclosing fence, with ponies and cattle looking on !

The first sowings were made in the spring and early summer of 1942 and when the seedlings appeared the ponies promptly nipped them off. Some of the more indigenous types—e.g., crested dogstail, *Agrostis* species and Yorkshire Fog, persisted, and on some of the areas so treated a temporary improvement over the old natural gorse and *Agrostis* herbage was clear enough but not, it was felt, sufficient to justify the expense.

It was then that the policy of enclosing and cultivating, for a period of five years with a view to growing much-needed food crops and eventually reseeding, was adopted and by the early spring of 1944 was put into effect. The plan was to enclose, reclaim, crop for three or four years, reseed, control graze for one year and then remove the fence. The cropping would be so arranged to ensure the establishment of a reasonably good ley with the minimum expenditure of public money. Experience of this work will be dealt with later in this article.

New Forest Stock Until recent years the cattle de-pastured in the New Forest have been dairy stock. Farms in the Forest and around its perimeter kept small dairies, and the cows ranged the Forest between milkings—a leader often provided with a bell. The more remote areas were grazed by young dairy stock which were brought in in the autumn. The herd was generally a mixture of hardy Channel Island types, and heifers often commanded a good price in Salisbury and other nearby markets, since they could be expected to do well under better conditions. Latterly there has been an influx of all breeds and their crosses, and the tendency, with one or two of the larger farmers with common rights, is to go over to Galloway cross beef cattle which, it is true to say, have thrived under Forest conditions. Stores brought on in May have graded out well as slaughter cattle in the autumn. It is doubtful whether the smaller commoners dependent on a regular milk cheque can afford to graze beef stores and wait longer for their return.

The New Forest pony is too well known to need description—over a thousand head now roam the open Forest, and a very hardy breed they are. It is true that they will thrive where cattle would find it difficult to live, but given the choice they will of course choose the better cattle grazings (or

" lawns " as they are known). So the more ponies there are, the less cattle can be maintained in the Forest.

Soils and Natural Herbage The soils of the open Forest are derived mainly from the tertiaries and are extremely acid ; *p*H values of 4.5 are common, the most severe acidity occurring on the Bracklesham and Bagshot beds, of which there are extensive areas. Interesting soil profiles showing " podsalization " are common on the faces of some gravel pits in these areas. The heavier Headon and Barton beds seem, probably by reason of their greater moisture capacity, to have attracted the attention of the earlier workers on this scheme. In addition to lime shortage, analysis has shown acute shortage of phosphate and potash. Table 1 gives examples of typical analyses.

Table 1

Site	Acreage	Available Phosphate *per cent*	Available Potash *per cent*	Calcium Carbonate	Lime Requirement *cwt. per acre* CaO	*p*H
Culverley ..	80	0.009	0.009	nil	45	4.6
Matley	38	0.010	0.010	nil	30	5.4
Greenmoor ..	35	0.003	0.003	nil	45	4.5
Wilverley Post ..	63	0.006	0.006	nil	45	4.8

Initial application of 5 tons per acre of ground chalk proved insufficient to neutralize the extremely acid state, and a second similar dressing was applied to the first areas so treated. Treatment of areas taken over latterly has consisted of an application of 5 tons per acre of a mixture of ground chalk and lime in the proportion of 75 and 25 per cent respectively, applied after the initial ploughing, and a second dressing of 5 tons before finally working down the seedbed for the first crop. In spite of this treatment, no serious deficiencies of minor elements have appeared. The Matley site showed slight signs of calcium deficiency in the potato crop taken after only one chalk application of five tons. The difficulty of achieving neutrality in lime status on these soils in a five-year period is indicated by the fact that recent tests on Culverley have shown a *p*H of 5.9, whilst Matley, which was originally one of the higher *p*H areas, shows only 6.5 now. In all recent tests too there is still an acute deficiency of phosphate (.006–.009 per cent), and potash contents have ranged from .003 to .009 per cent, indicating marked to slight deficiencies.

Available phosphate deficiency, which was accentuated by such heavy lime dressings, was guarded against on areas latterly tackled by an initial dressing of 4 cwt. per acre of superphosphate worked well into the seedbed, in addition to the normal dressing of compound fertilizer—generally National Compound No. 1—applied to the crop.

The natural herbage of the open Forest is predominantly heather—*Erica cinerea* and *E. tetralix* with *Calluna vulgaris*, but there are considerable stretches of bracken and gorse. In association with the heathers are *Molinia* and *Nardus stricta*. *Agrostis* sp. too are common with, here and there, some Yorkshire Fog and a little crested dogstail. In selecting areas for this work, the old saying—

Under bracken lies gold,
Under gorse lies silver,
Under heather lies lead.

Photo: *Philipps*

Marley Mount, central area, before reclamation

Photo: *D. R. Bruening*

Close-up of new ley at Marley Mount

Photo: *A. E. Rice*

Atlé wheat at Wilverley Post (Naked Man), showing natural herbage alongside

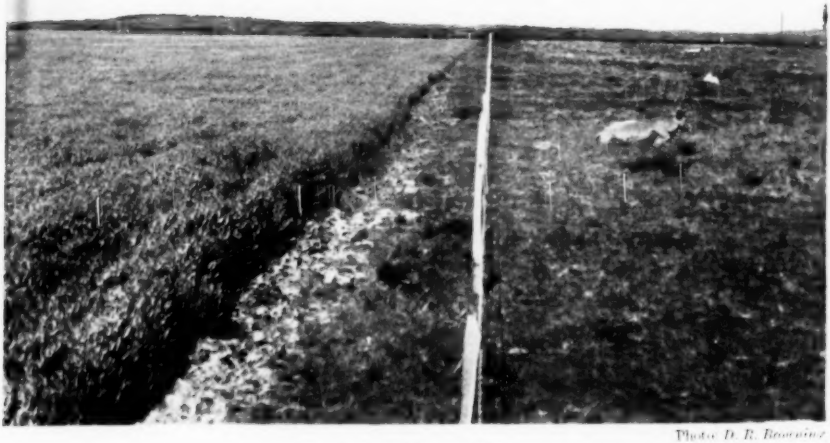


Photo: *Dr. R. Bonnier*

Star Oats at Wilverley Post

Concentration of stock at Longslade Bottom

Photo: D. E. Browning

General view of Longslade Bottom

Photo: Farmer and Stockbreeder

Sheep folded on sweet yellow lupins in Suffolk

Bitter lupins being rolled and ploughed in for green manure

has been a useful guide but it is not infallible ; the bracken must be strong growing and not too much intermingled with heather ; the gorse too should be prolific, not merely an odd stunted stem with heather as the major plans population. It can be taken as almost certain that land on which there it little bracken or gorse is unsuitable for this scheme of operations ; even this land could be improved, but to attempt to grow crops profitable enough to pay for the fencing and reseeding is folly. *Molinia* land is usually too wet.

Drainage The open heathland areas on the Bracklesham and Bagshot beds present few drainage problems, and where the work of cultivation has overlapped on to such areas the pan has been broken and water gets away. In their virgin state water tends to collect on the flat plains, and there are bogs too, especially on the northern slopes. The better class land lies often, though not invariably, in the valleys, and they have to be " prospected " carefully so that in the eventual enclosure, wet spots are, if possible, avoided.

In general, the drainage of the Forest is a matter of open ditches, the water finding its way eventually to the Beaulieu, Lymington and Avon rivers, although the latter does not take much of the water running off the Forest.

Reclamation Technique The actual method of reclamation varied, according to the natural herbage present and the depth of the soil. Where work was done on the shallower land, the predominant herbage was stunted bracken and *Agrostis* sp., and here it was usually possible to plough with the ordinary type of plough. Where there was prolific bracken growth there was also good soil depth and, without doubt, the prairie buster was the best tool. Gorse land was a different story, and the easiest way here was to burn the gorse the year previous to cultivation ; the unburnt stems then became brittle, were chopped up easily with a heavy disc harrow or polydisc and the land ploughed with the prairie buster. The first ploughing was best done in June or July and the land thoroughly fallowed for the rest of the summer. Oats or potatoes have proved the best first crops. On the good bracken land potatoes are best, as they provide a second-year fallow break in which to administer shock tactics to the bracken. On the poorer land potatoes fit in better later, as the manurial residue of the liberal fertilizer dressing helps more in the subsequent establishment of the new ley. No special problems have arisen in subsequent cultivational work, except in some of the wet areas to which reference has already been made.

It will be readily seen that owing to the limited period during which the land is enclosed, its farming is not an ordinary undertaking ; and neither is it just a case of cashing virgin soil fertility and sowing back to indifferent grass. The distances separating the sites tackled have also added to the problems, and it has been always a matter of careful planning to avoid road transport and loss of time.

There is one other point of interest : initially, areas were selected and fenced, then reclaimed. This was done to avoid possible damage and accident to ponies and cattle and to riders, but in some instances it resulted in much larger areas being enclosed than could, because of poor soil conditions not at first apparent, be ploughed. Latterly much more faith has been placed in the instinct of ponies and cattle and the good sense of riders ; ploughing has been done first, the fences being erected after.

NEW FOREST PASTORAL DEVELOPMENT SCHEME

Area Treated The sites selected in 1944 were :

	acres
Blackhamsley	44.5
Black Knowl	149.0
Longslade Bottom	87.0
Marley Mount	91.75
Whitefield Moor..	99.0
Yew Tree Bottom	23.0
	494.25

The subsequent history of these areas has to be divided into three parts :

(*a*) Land which proved so intractable due to bad drainage that direct reseeding was the only course :

(i) Marley Mount (western side) 27 acres.

(*b*) Land which appeared suitable for cultivation but due to bad drainage was subsequently abandoned for arable crops and reseeded direct.

	acres
(i) Marley Mount (central area)	43
(ii) Black Knowl (western side)	70

(*c*) Land which proved successful for arable cultivations :

	acres
(i) Marley Mount (eastern side)	24
(ii) Yew Tree Bottom	23
(iii) Longslade Bottom	87
(iv) Blackhamsley	45
(v) Black Knowl (eastern side)	45
(vi) Whitefield Moor	99
	323

Little need be said about (*a*) except that in sowing it down, opportunity was taken to vary the mixtures with a view to observing later their ability to stand up to the unrestricted all-year-round grazing. The area was reseeded direct in August, 1945, and eighteen months later the enclosing fence was removed. Reversion to indigenous grasses has taken place and rushes and gorse are prolific. Seeds mixtures in which indigenous grasses were sown have shown little, if any, advantage over the pedigree grasses in their ability to withstand the severe grazing. The wild grasses replace the S. strains eventually but with the latter there is the added advantage of greater bulk of grazing for the first two or three years. Crested dogstail did, however, appear to be a useful grass to include, and this opinion was shared by Sir George Stapledon, who has visited the reclamation sites ; it has been included in mixtures sown down on later areas.

As to (*b*), after intense efforts to grow arable crops, a decision was taken in 1946 to sow down these areas direct ; and in July, 1947, this was done. But in both these areas, to try to counteract the excessive wetness, the final ploughing was done on the narrow land or ridge-and-furrow system, the distance between each ridge and furrow being exactly one drill width. This has had the desired effect—where care was taken to see that water in the furrows had a getaway at the ends—and there has been no excessive wetness at any spot on these sites. This is an interesting reversion to the common

practice of our forebears. The mixture sown on the Marley Mount area was :

	lb.
Italian ryegrass	6
Commercial timothy	6
S.143 cocksfoot (30 per cent germination)	30
S.100 clover	2

The cocksfoot was available from Committee land on the chalk and, with its low germination following a difficult harvest, was not saleable. From the state of the sward it produced in the first year it appeared that seeds which failed to germinate under official tests grew under New Forest conditions ; cocksfoot dominated the new ley. Yorkshire Fog also made its appearance, however, in the second year and the sward seems now to have settled down to Yorkshire Fog, cocksfoot, and white clover mixture and, as the illustration on page (i) of the art inset shows, the clover is profuse—certainly proof that grazing encourages clover. The fence around this area and that around the western side of Black Knowl was removed on April 1, 1949, and since then the leys have had no respite, nor have they had any manurial or cultivation treatment. On Black Knowl gorse is asserting itself rapidly, and reversion to its original condition is only a matter of time.

Dealing now with the areas listed under (*c*), all were treated differently with the exception of Blackhamsley and Whitefield Moor. The last crop on these two sites was Atlé wheat in 1948. It had been intended to undersow this crop with the ley mixture, so as to allow control of grazing during the winter of 1948 and spring of 1949, but the spring growth of wheat (which eventually threshed out at 22½ cwt. per acre) was in both cases so prolific that the seeds mixture seemed to have a poor chance. The seeds were therefore drilled direct in April, 1949, grazing being controlled only until Michaelmas of that year, when the enclosing fences were removed. Although the seeds mixture (24 lb. per acre of Aberystwyth strains) was cross-drilled, it has never properly filled out and ground cover is not good. Whitefield Moor was originally heavily infested with bracken, and this weed is again making its appearance. In the absence of any attempt at control, it will undoubtedly re-establish itself. Marley Mount (eastern side) carried a useful crop of Star oats in 1948 and was undersown to a mixture of 14 lb. perennial ryegrass S.23, 3 lb. S.48 timothy and 3 lb. S.100 clover that year.

Yew Tree Bottom was sown to a crop of S.147 oats for the 1948 harvest, and this crop showed such vigorous growth that the grass seeds were kept in store. The crop was taken off (27 cwt. per acre), the stubble ploughed and the grass seeds sown direct in October of that year—a risk which came off. In common with other direct reseeded areas, a heavy growth of weeds came on, including fat hen, groundsel, *persicaria*, and a host of others. At first alarming, they in fact did some good in protecting the young seeds and were easily stripped off with a mower—cattle appearing to relish them in their withered state. The mixture sown on this area was predominantly ryegrass—7 lb. S.101 and 7 lb. S.23 with 3 lb. S.143 cocksfoot and 3 lb. S.100 clover. It has been noticeable that ryegrasses at certain stages of their growth seem to be less palatable and are inclined to run up to seed even under uncontrolled Forest conditions, whereas the cocksfoot leys have throughout the season attracted large numbers of grazing animals. It may well be that ryegrass swards will, for this reason, survive longest under these conditions.

Longslade Bottom grew linseed in 1948. The technique here was to mix 80 lb. of Royal linseed with 20 lb. of grass seeds and cross-drill the mixture

at 50 lb. per acre both ways with a combine drill. This worked well and the linseed was harvested without trouble with an ordinary wheel-drive binder, yielding just under 8 cwt. per acre when threshed. The ley mixture was 7 lb. S.143 cocksfoot, 7 lb. S.26 cocksfoot, 3 lb. S.100 and 3 lb. S.123 clover and has provided considerable grazing for cattle and ponies which seemed to congregate on it from all over the Forest. How long it will withstand the treatment remains to be seen. Black Knowl (eastern side) was treated similarly to Longslade, except that the mixture was 14 lb. S.48 timothy, 2 lb. S.100 clover and 2 lb. S.123 clover, and this made all the difference. By the time harvest was reached, the timothy was well above the linseed and it was impossible to cut with the binder. To salve as much as possible of the linseed and to save the ley, the whole lot was cut with grass mowers and made into " hay " which eventually threshed out at 5 cwt. linseed per acre.

The object in sowing various mixtures was twofold—first to gain further experience of the best grasses for the rather unusual subsequent ley " management" and secondly to ensure that for the first year when control of grazing could be exercised there should be a succession of areas available for grazing at different times. Since the fences have in all these cases been removed, the initial advantage in this direction has disappeared, for, with the possible exception of ryegrasses, the cattle and ponies seem to nibble them incessantly throughout the year. It is perhaps an opinion worth recording that any of the leys—regardless of the mixture—would have a longer potential life if grazed alone by cattle. It is a fact that ponies will fatten where cattle will starve and whereas cattle under open range conditions will move on to other land when they have bitten down a ley, ponies will stay on and on.

1946 Areas Two more areas were selected in 1946 :

	acres
Culverley	80
Matley	38

Culverley carried a crop of barley in 1950, and Matley a crop of S.225 oats as the final crops in their arable rotation. They were both undersown, and the new leys, which now show up extraordinarily well, have been grazed under control this summer before pulling down the fences. So-called control is exercised by notifying the local agisters and opening gates in the enclosing fence. When the ley has been eaten off, the fences are closed again.

So far no major nutritional troubles among Forest animals grazing on new leys have been reported. An odd case of the " bad-doer," or even death, has occurred but has been emphasized by the considerable number of cattle congregating on the new areas, thus focusing the attention of the passer-by. Access to unlimited areas of roughage has probably prevented blowing, and few, if any, cattle have suffered in this way.

1948 Areas The final selection to complete the scheme was made in 1948 and consisted of :

	acres
Wilverley Post (Burley Rocks)	63
.. .. (Naked Man)	67
Beaulieu Rails	28
Greenmoor, Pilley Bailey	35
Hill Top, Beaulieu	20
Matley Heath	14
Backley	26

With the possible exception of the last two, these areas have proved the most fertile of any selected and are now being put through their rotation. Yields for the two years 1949 and 1950 are shown in Table 2.

Table 2

Enclosure	*Yield per acre* 1949	*Yield per acre* 1950
Burley Rocks ..	23 cwt. Star Oats	10 tons Potatoes
Naked Man ..	8 tons Potatoes (+ 10 acres Turnips after early Potatoes)	23½ cwt. Atlé Wheat
Greenmoor ..	17 cwt. Dredge	11 cwt. Linseed
Beaulieu Rails ..	16 cwt. Atlé Wheat	9½ tons Early Potatoes
Hill Top	Fallow Crop (Turnips and Rape)	14 cwt. Star Oats

Matley Heath and Backley are both much more gravelly than other sites. Backley, being situated on the northern side of the Forest was selected for investigational work in that area, and in spite of depredations by numerous deer yielded 18 cwt. oats per acre in 1950.

Future Work The scheme described in this article was essentially a war-time conception and when completed, will cover roughly 1,000 acres, as agreed between the Committee, the Commoners and Verderers, and the Forestry Commission. One broad conclusion can be reached—that this scheme has demonstrated the superiority of the " enclosure arable cropping, reseeding" system over the " non-enclosure direct reseeding " method. Provided control of grazing can be exercised for at least a year after reseeding, the resulting new ley has a much longer potential life under open range conditions.

Since the scheme was conceived, the New Forest Bill has passed through all its stages and is now on the Statute Book. This Act (The New Forest Act, 1949) provides under Section 14 (1) that :

> The Verderers may from time to time on a presentment made by them to the Minister, after the publication by the Minister of such notice of the proposed presentment as appears to him requisite for informing persons concerned, authorize the enclosure by the Minister, for the purpose of cultivation and the improvement of grazing, of such land in the Forest as the Verderers may specify, in addition to the land which may be enclosed apart from this section ; Provided that the total area of land which may be enclosed at any one time by virtue of this section shall not exceed three thousand acres.

It is thus clear that if any more work of this nature is to be done in the New Forest, whether for the benefit of the Commoners or the nation generally, it must be done under the conditions imposed by the Act. There can be little argument that the work is beneficial, but inevitably the question arises—"Who pays ?" and some means must be found, if any work is to be done under the Act, of financing it.

SOME ASPECTS OF CABBAGE ROOT FLY ATTACK IN THE FIELD

MARY MILES, M.Sc.

Wye College, University of London

If the most effective and economic use is to be made of the various insecticides now available in the fight against pests, it is essential that their life histories and habits should be fully understood. Observations on cabbage root fly at Wye College indicate the importance of timing control measures correctly.

THE cabbage root fly (*Erioischia brassicae* Bché.) is a serious pest of brassica crops in Canada and the United States, in Northern and Western Europe and across Asia to Manchuria and Japan, and in most of these regions it has been under observation for over half a century. Up to about 1925 attention was concentrated on field studies of the flies, and much of our basic information on their life history and behaviour is derived from the writings of Canadian and American entomologists working at that time. About 1925 it became generally known that corrosive sublimate (mercuric chloride), originally used to check Club Root, and calomel (mercurous chloride) were effective in controlling the insects, and from then onwards research work consisted mainly of experiments using these and other insecticides. The introduction of DDT and BHC added to the number of insecticides available, and the growers' interest in them demonstrated that the practical problems of control in the field were still not solved.

In the case of cabbage root fly the use of an efficient insecticide is not enough to ensure satisfactory control. Detailed knowledge of the life history and habits is essential if insecticides are to be used effectively and economically.

Field Attacks by Various Species There seems little doubt that over most of Britain the cabbage root fly (*E. brassicae*) is the most numerous and injurious species. On the other hand, the larvae of four additional closely allied species are sometimes to be found at the roots of cabbages, cauliflowers, swedes, turnips and other brassica crops.

The turnip fly (*E. floralis* Fall.) (1) occurs in Scotland (2), and in Northern England, but it does not appear to occur further south. It is widespread in Scandinavia, Germany and Russia, where it causes serious injury ; it is also known in Canada (3), but not in Northern France (4). It is a true root fly and feeds at the roots of cultivated brassicas, but its distribution appears to be limited to the more northerly latitudes of the north temperature zone. Its habits resemble those of the cabbage root fly but it emerges later in the season. It has one and sometimes two generations a year. In an outdoor insectary at Wye in 1950 a partial second generation emerged in the third week in September and laid eggs. This northern cabbage root fly is especially interesting for, although in Europe it seems to be limited to northerly regions, it requires a long exposure to the warmth of spring and early summer before it emerges from the winter resting stage (puparium). In 1950 and 1951 the common cabbage root flies began to emerge in captivity at Wye in April, but the northern species, which was maintained under the same conditions, did not emerge until July.

SOME ASPECTS OF CABBAGE ROOT FLY ATTACK IN FIELD

Maggots of the bean seed flies (*Delia cilicrura* Rond. and *D. trichodactyla* Rond.) often occur on cruciferous crops in spring and summer, in company with those of cabbage root flies, and they have been found widely distributed in a crop of spring cabbages in late October and early November when cabbage root flies were not present (5). Attack on brassicas by bean seed flies is recognized in Europe and America and in some circumstances it causes much damage. The bean seed flies are primarily scavengers which are attracted to freshly turned soil, and their maggots feed indiscriminately on available vegetable and animal matter (6). The preparation of soil for brassicas and cultivation around established plants at times when the flies are active are sufficient to attract them and lead to attack on the crop. The differences in the habits of the bean flies and the cabbage root flies are so great that control measures directed against cabbage root flies are ineffective against bean seed flies.

Cruciferous crops that have been attacked by cabbage root flies, bean seed flies, stem flea beetles (*Psylliodes chrysocephala* Linn.), stem weevils (*Ceuthorhynchus quadridens* Panz.), stem miners (*Phytomyza rufipes* Mg.) and cabbage aphids tend to decay and attract scavenging insects. Conspicuous among these is another fly—*Pegohylemyia fugax* Mg.—which lays eggs freely on the leaves and stems, and whose maggots are often found in large numbers in rotting tissue. A study of the feeding habits of the maggots and the recorded occurrences of the flies (6) showed that they were primarily associated with decaying tissues in many crops, including beet, spinach, oats and carnations. The maggots have the same general appearance as those of the cabbage root flies, but when magnified they are seen to have a conspicuous head and, at the hind end, a well marked ring of pointed projections, one of which is forked, while cabbage root fly maggots have a small head and less conspicuous ring of tail projections, two of which are forked. The maggots of this fly are often found in Brussels sprouts and cauliflowers of poor quality, but they are not the cause of this condition and their presence can be ignored.

Spring Peak of Egg Laying The emergence of cabbage root flies in spring is governed by the cumulative effects of soil temperature and moisture, and nothing is known about the field conditions inducing it. Observations on the time of emergence are difficult to make because flies emerging in dull, cold weather shelter in the soil or in the herbage until stimulated to activity by sunshine. The life of the flies extends over several weeks and there is no doubt that emergence may occur some time before the period of mass activity associated with the peak of egg-laying.

Since eggs and newly hatched maggots are the only stages of the life cycle vulnerable to control measures, it is important to know when the spring peak of egg-laying takes place. Observations at Wye during the period 1948–51 showed that this varied from year to year, but it was so closely associated with weather conditions that it could be anticipated and prepared for. In 1948 eggs were first seen on April 14, and in the warm, sunny weather of the following week the numbers of eggs rapidly increased. In 1949 eggs were first seen on April 20 and in the warm, sunny weather then prevailing the numbers increased rapidly, until counts showed that there was an average of over a hundred eggs per plant. In 1950 eggs were first found on April 22, but low temperatures and bad weather so limited the activity of the flies that the peak of egg-laying was delayed until May 9–13. In 1951 eggs were not found until May 2. The numbers of eggs increased very slowly and on May 19 they were found on less than half the plants

examined and there were usually less than ten. The weather then became warm and sunny and, in a few days, eggs, often more than a hundred, were found at all the plants examined.

Common features of the period of mass activity and the peak of egg-laying in the four consecutive years were high temperatures (maximum day temperatures of over 60°F.) and long periods of sunshine. It was noted that in each of the four seasons egg-laying activity reached its peak in the first prolonged period of warm weather after the middle of April. The weather conditions inducing activity among the flies at Wye were similar for much of Britain, and it is reasonable to assume that cabbage root flies over a large area were similarly affected.

It is probable that local conditions have an important influence on the time and intensity of field attack but, so far, no evidence of this has been collected. The aspect, colour, texture and water-holding capacity of the soil affect the rate at which its temperature rises in spring, and areas favourable to the early growth of plants are likely to favour the early emergence of cabbage root flies. Whether this will be reflected in early field attack will depend on the subsequent weather. Although mass activity is delayed by adverse weather, some egg-laying takes place in sheltered situations.

Attacks in Summer and Autumn Weather conditions and farming practice have a bearing on the signs of attack in the field. Hot, dry weather promotes the wilting of damaged plants and exaggerates injury by cabbage root flies. In rainy weather the injury is masked, more plants survive, and the apparent freedom from attack is deceptive. In the field under observation at Wye the crop was irrigated in order to maintain favourable growing conditions, and populations of 60–80 maggots per plant appeared to have no ill-effects on the health and vigour of established cauliflowers (7).

The long life of the flies and the over-lapping of the generations are associated with the presence of eggs at the host plants from about the middle of April to early October, but the numbers of eggs laid tend to be small for some time after the spring peak. For this reason Brussels sprouts, winter cabbages and savoys set out at the end of May and early June usually escape serious attack. Broccoli and late cauliflowers planted in late June and early July are exposed to attack by the second generation of egg-laying flies before they are well established. Since the activity of the summer generation is rarely limited for any considerable period by adverse weather, the summer peak of egg-laying is less marked, but plants set out in dry weather may show signs of distress when attacked by only a few maggots. In wet summers cabbage root fly attack passes unnoticed, but the presence of stunted, highly coloured plants in the crop later in the year is generally an indication that root fly maggots have been active.

Cabbage root flies of the second and third generations are active during September and egg-laying flies have been captured in south-east England in mild weather as late as October 12. At this time of the year the flies seem to be attracted mainly to large plants, and eggs are laid freely among the leaves and shoots. Many maggots feed in the upper parts of the plant and may cause damage to cauliflowers and Brussels sprouts. Attack at the roots goes on simultaneously, and considerable injury may occur to the crowns of swedes and turnips.

Autumn attack on spring cabbages by bean seed flies is not well known but occurs when the crop is set out while the last generation of flies is still active.

SOME ASPECTS OF CABBAGE ROOT FLY ATTACK IN FIELD

Attacked plants do not usually die but their growth is checked and there is evidence that bolting in spring and the development of soft roots may result from the injury.

References

1. Common Names of British Insects and Other Pests. *Assn. appl. Biologists*, 1947.
2. Turnip Root Fly Problem. G. D. MORRISON. *Aberdeen Press and Journal*, January 21, 1937.
3. The Identification of the Commoner Root Maggots of Market Garden Crops in Canada. A. R. BROOKS. *Dom. Ent. Lab. Saskatoon*, 1949 (cyclostyled).
4. Les Insectes Nuisibles aux Plantes Cultivées. A. BALACHOWSKY and L. MÉSNIL. Paris, 1935.
5. Field Observations on the Bean Seed Fly (seed corn maggot), *Chortophila cilicrura* Rond. and *C. trychodactyla* Rond. M. MILES. *Bull. ent. Res.*,1948, **38**, 559.
6. Studies of British Anthomyid Flies. M. MILES. Ibid., 1950, **41**, 343.
7. Observations on the Biology and Control of the Cabbage Root Fly, *Erioischia brassicae* Bché. M. MILES. *Ann. appl. Biol.*, 1950, **37**, 260.

LUPINS FOR SANDY LAND

A. W. OLDERSHAW, M.B.E., B.Sc., N.D.A.

Lupins are grown in various parts of the world for the feeding of farm animals and as a soil improver. Mr. Oldershaw, who has for many years been interested in the crop, claims that its possibilities, especially on sandy land where other leguminous crops may fail, should be more widely known in this country.

OUTSIDE Suffolk, lupins are not well known in Great Britain as an agricultural crop, yet their value for feeding stock and improving soil fertility in light sandy areas is such that they are deserving of more attention. Interest in the crop in some countries overseas is already marked. In Germany, for instance, a considerable acreage is grown, for which, in the 1948-49 season, over 2,000 tons of seed were supplied from the sterling area (mostly from New Zealand). In Western Australia [1] the blue-flowered *lupinus varius* has proved itself of great value not only in the reclamation of poor, wind-eroded land but also as a very welcome, protein-rich supplement for sheep and cattle during the dry summer months. It is stated [2] that 10-16 wethers or 2-3 cattle can be fattened on it to the acre, the animals eating the pods and dry foliage. Great interest has also been shown in the possibilities of lupins in New Zealand [3, 4, 5], South Africa (where they are used to provide organic matter in vineyards), Chile, and Holland, where a variety of the sweet yellow lupin Neven has been produced.

With these examples before us and in the light of our own commercial and experimental experience in Suffolk, we should do well to explore the potentialities of the crop in suitable areas of Great Britain. Lupins grown for seed are essentially a crop for very light, sandy land and will thrive in a soil so acid that any other leguminous crop will fail completely. As far as is known, most kinds of lupins will grow on neutral soil, but apparently they will not succeed on a soil containing much lime. It seems unlikely that the crop can be relied upon to ripen its seeds satisfactorily, except on the lightest soils of the south-east and Midlands of England. Even in Suffolk it has been found that in wet seasons lupins may grow too much green material to obtain a heavy yield of seed. If, therefore, the crop is to become more popular for green manuring and soil improvement, and (in the case of sweet lupins) for silage or as a forage crop, growers will

probably have to look to sandy land in dry and early districts for a supply of seed. The west and north, although not well suited for seed production, may, on suitable land, grow large quantities of greenstuff for silage or folding in the case of the sweet varieties, and for ploughing in green in the case of the bitter types.

Varieties There are many varieties of lupins, but only those likely to be of value in Britain need be mentioned:

BLUE-FLOWERED. The seeds are grey and usually contain 28–35 per cent crude protein.

Bitter Blue, usually containing 1–3 per cent of the bitter, poisonous alkaloid *lupanin*.

Sweet Blue, containing only a trace of *lupanin*—0.02–0.25 per cent.

YELLOW-FLOWERED. The seeds usually contain 35–48 per cent crude protein.

Yellow-flowered with mottled seeds.

(a) *Tunstall Yellows*. The *lupanin* content varies considerably, but it is often about 0.5 per cent. This variety should probably be classed as intermediate rather than sweet.

(b) *Neven*, which may contain less than 0.1 per cent of *lupanin*, i.e., "Sweet".

Yellow-flowered with whiter seeds.

Weiko. The *lupanin* content may be less than 0.1 per cent, i e., "Sweet".

Lupins have been grown successfully on very light sand of *p*H 4.5, but failure has been reported on soil with a *p*H of 3.5. They have been grown successfully at Tunstall Experimental Station on soil so acid that barley, sugar beet and peas fail completely and the crop of potatoes is seriously reduced.

All varieties of lupins greatly enrich the soil through their leaves and roots even when the crop is harvested for seed. The deep tap-root carries numerous fleshy nodules containing nitrogen-assimilating bacteria. The coarse stalks when threshed resemble bean straw; they break up and make excellent material for cattle yards, for stack bottoms, or for covering clamps. Being very rich in nitrogen, they make good manure which enriches the soil still further.

When folded with sheep, the soil benefits considerably, owing to the highly nitrogenous character of the food and the plant's extensive root system. When ploughed in green, the land is enriched in humus, and this serves to some extent to take the place of farmyard manure, which is often scarce and costly to apply. Although lupins are normally grown on lime-deficient soil, which often lacks phosphate and potash as well, they have a great capacity for taking up these plant foods from the soil, and the ash of lupins contains much valuable mineral matter. This mineral matter seems to be readily assimilated by succeeding crops if the straw is returned to the soil or if the green crop is folded on the land or ploughed in. This, together with the large amount of nitrogen* accumulated, may explain why it is very unusual for any crop following lupins to do poorly. Bitter blue lupins have been grown as a soil-improver in various parts of Britain with great success.

* The green material of all lupins contains a very high percentage of crude protein (often about 20 per cent in the dry matter) and, in consequence, of nitrogen.

LUPINS FOR SANDY LAND

From 1926 until the present time lupins have been grown on much of the land at Tunstall Experimental Station, usually once every four years. In 1926, 1927, and 1928 dense crops of 3 feet or more in height, were ploughed in green. This is about as much as can conveniently be ploughed in green. From 1929 the lupin crops were harvested for seed. No farmyard manure was applied for twenty years from 1923, but the fertility of the land seems to have increased considerably—probably due in part to the lupins.

Mr. G. F. Ross, formerly of Dunragit, Weigtownshire wrote : " We have grown lupins here for four years now, entirely for green manuring. Growth has been most luxuriant. After early potatoes, which are grown every year on the same land, we have a growth of 3 feet 6 inches to plough in. The crop of potatoes the following year was greatly increased—actually a 4-ton increase on two acres." These were bitter lupins.

Mr. E. Shaw-Browne of Clipstone, Chairman of the Notts A.E.C., told the writer in 1950 that partly with the aid of bitter blue lupins ploughed in green, he had brought light land into a high state of productivity.

Culture The light, sandy soil which is suitable for the growing of lupins should normally be ploughed or broken up to a depth of 10-12 inches in order to break up any pan. The tap-roots of the lupin penetrate to a great depth and hence are able to obtain moisture and minerals from the lower depths of the subsoil. It is generally recognized that it is of no use putting beans or peas on foul land and expecting a good crop: this is equally true of lupins. Lupins require the soil to be fairly firm before drilling. After ploughing the land should be harrowed. If thistles or other deep-rooted perennial weeds are present and the land has been ploughed some time previously, it may be desirable to run over with a cultivator with cutter blade attached, or to horse-hoe. This should be followed with a heavy roller.

The seed should be drilled about 1 inch deep unless the soil is dry, when it may be put a little deeper to enable it to reach the moisture. Rows should be 14–18 inches apart to permit of horse- or tractor-hoeing. If broadcast, care must be taken that the seed is buried to a depth of 1 inch and the soil well consolidated around it, otherwise the germinating seed may rise to the surface and then dry out and die. Sweet yellows, owing to their bushy habit of growth, may be sown wider apart than blues. If growing for seed, sowing should if possible be in April; if for a green crop, it may be in April, May, June, or July, provided there is plenty of moisture. No manure appears to be necessary. The crop at Tunstall has been seen to make more vegetative growth on land which received farmyard manure the previous year, but too much stem and leaf growth may be a disadvantage for seed production.

If the seed is of very high germination, 5–6 stones per acre of sweet yellows and 6–8 stones of bitter or sweet blues have been found to be sufficient. The germination should be tested before sowing. When not too thick, lupins make a very good nurse crop for grass and clover seed and for lucerne. As a nurse crop for lucerne they have been used most successfully by Sir Peter Greenwell at Sudbourne, Suffolk. There is good reason to believe that when lupins have not been grown before, it is wise to inoculate the seed with a culture obtainable from Messrs. Allen and Hanbury, Bethnal Green, London, E.2. Alternatively, soil from a field which has previously grown lupins may be mixed with the seed before drilling.

When the plants are 2 to 4 inches high, the land should be harrowed across the drills to kill spurrey or other weeds, but as the plants are very brittle

this work should be stopped if too many lupins are broken off. The horse- or tractor-hoe should be used twice if possible. On the very light, sandy soil which is suitable for lupins, a fair, but not too heavy, rainfall is desirable, but when the crop is grown for seed, a very wet season produces too much straw at the expense of seed, as is the case with beans, peas, and clover. Many failures of sweet lupins have been due to attacks by rabbits and hares ; the two seed-leaves may be bitten off and the crop ruined before the farmer is aware of the attack. It is useless trying to grow sweet lupins unless they are protected from these pests. Bitter lupins are not seriously damaged.

The crop should be cut before it is dead ripe, when the dew is on, or in cloudy weather. In hot, sunny weather loss of seed may occur by shelling with the older varieties, but not with the newer, non-shattering kinds. The binder is suitable for blues. Sweet yellows do not really need tying up, since they hang together very well and dry better untied. Layers of straw and a ventilating shaft help the seed to dry in stack, and narrow stacks in a good drying position are an advantage.

In considering the yield of seed per acre, it must be remembered that lupins of any kind are suitable for growing on very poor, sandy land, on which *all* crops give small yields. They will also grow on land which is so acid that it will grow no other farm crop except rye and oats and possibly potatoes. On such land 15 cwt. of bitter blue lupins is a good crop. Lupins, like beans, peas and clover, fluctuate greatly in yield of seed from season to season. At Tunstall sweet yellows yielded 17 cwt. of seed per acre one year, but only 7 cwt. the following year—a very dry one. Sweet blues yielded 14 cwt. one year and 8 cwt. the next.

Utilization of the Crop In spite of the poisonous alkaloid *lupanin* present in considerable quantities, bitter blue lupins have been folded with sheep by many Suffolk flock-masters. There is some risk of poisoning, and the sheep should have a run on other food and not be allowed on the lupins when hungry ([6,7,8]).

Some years ago a stock of sweet blue lupins of German origin was sent to New Zealand. In that country they have been found very valuable for fattening lambs ([4,7]). The total liveweight increase with these animals on 3 acres of rape was 595 lb., and on the 3 acres of sweet blue lupins 1,068 lb. Many stocks of sweet blue lupins grown in this country came from New Zealand. The grain fed to cows in England gave similar results to the use of beans, equal parts of lupins and oats or beans and oats being used. The mixtures were fed at the rate of 4 lb. per gallon of milk yielded, and the animals received about 5 lb. of lupin meal per day. There was no drop in the milk yield as a result of feeding the sweet lupins, the health of the animals did not suffer in any way and there were no complaints regarding the quality of the milk. In Suffolk, the grain has been fed to poultry and the green material to cattle. Sheep have grazed the crop with good results. In Wales a lupin-Italian-ryegrass mixture was used and it gave a better liveweight per acre increase than a rye-ryegrass mixture.

A stock of sweet lupins (from New Zealand) originally very low in *lupanin* (0.06 per cent) and grown at Tunstall Experimental Station for the first time in 1945, had in 1950, 0.25 *lupanin* which is tolerably low. During the period it had been protected from rabbits and had not been mixed with bitter blues, but had been exposed to cross-pollination from an adjoining field of bitter blues. The same stock grown on another Suffolk farm from 1946–49, was exposed to attack by rabbits every year. The 1949 crop had a *lupanin* content of 2.24 per cent and could no longer be regarded as sweet. It is

quite likely that all stocks of sweet lupins contain a few bitter plants. If the growing crop is attacked by rabbits, which eat only the sweet plants, it is evident that in time the stock will become bitter. Besides the possibility of cross-pollination, reversion may also take place. Neither the plants nor the seeds of the sweet blue variety can be distinguished from the bitter blue by external features. In New Zealand, to protect purchasers, sweet blue lupin seed has to be certified under a Department of Agriculture scheme.

The Tunstall stock of intermediate yellows was raised at Tunstall Experimental Station, Suffolk, from a very small quantity of seed sent to the writer by the National Institute of Agricultural Botany about 1937. At a hot, dry harvest time the pods split and shed their seed, and much loss may result unless the crop is cut before it is dead ripe. Both seed and green plant are slightly bitter, the seed containing about 0.5 per cent of total alkaloid as *lupanin*. For some years they were probably the only kind of sweet lupin available in this country. When grown for green fodder mixed with rape they were successfully folded by sheep in Suffolk (4) but in Wales, Clun Forest lambs refused them—no doubt because of their slight bitterness. The seed was fed at Weybridge to rabbits, poultry and a cow, to poultry at Cambridge and Sonning, and to pigs at the Royal Veterinary College, in all cases without harm resulting. Seed has also been fed to poultry on four Suffolk farms and, mixed with oats, to cows. These results from the Tunstall Yellow which often contains 0.5 per cent of *lupanin* and is hence not particularly sweet, indicate that should sweeter varieties become available in quantity, they might be extremely valuable as stock feed. Non-shattering varieties of yellow lupins, such as Weiko, which are also very low in *lupanin* may supersede this variety, but Tunstall Yellow does not suffer from the attacks of rabbits to quite the same extent as do the very sweet varieties. In rabbit-infested districts slight bitterness might be an advantage.

The seed of the Weiko white-seeded, yellow-flowered, sweet lupin was discovered by the scientists of the Kaiser Wilhelm Institute, Berlin, during the 1939-45 war. It has the advantage over other sweet lupins that the pods do not burst when ripe. This was certainly the case at Tunstall and Knodishall. *Captain G. W. Bevan-John* of B.O.A.R. who reported the discovery, goes on to say : " The seed is extremely palatable to animals and human beings. The straw is of greater feeding value than oat straw." The seeds taste much like haricot beans. At Bucklesham they were eaten by the men engaged in threshing in the same way as blue peas are often eaten.

Capt. Bevan-John obtained his Weiko seed and the seed of another variety from Dr. Lehrkamp of Elahsheide Church Farm, Paderborn, Germany. Dr. Lehrkamp, said to be the greatest exponent of lupins in Westphalia, told Capt. Bevan-John that sweet lupin seed, grown on sandy soils, is used for feeding cattle. The best of the yellow lupins is the Weiko ; they do not burst their pods when ripe—a very common fault with other kinds, and the grain is better than soya bean. Weiko has been grown on a small scale with success at a number of centres in England.

Crop Yields *Dr. H. H. Mann* reports regarding trials at Woburn Experimental Station on the light land of Bedfordshire as follows :

In August, 1948, Tunstall sweet yellows gave 14 tons of greenstuff per acre.
In 1948 white-seeded sweet yellows gave enormous crops of greenstuff, which the cattle ate well.
In 1949 seed was damp after the wet harvest in 1948 and did not germinate well.
In August, 1950, Weiko white-seeded sweet yellows gave 17 tons of green material, which was eaten by pigs. The yield of seed was substantial and gave a 93 per cent germination.

Mr. S. Culpin of Gleadthorpe Experimental Husbandry Farm, Mansfield, Notts, on the sand-land area of Sherwood Forest, reports that in 1950, Weiko and Neven sweet yellows, both gave about 8 cwt. of seed per acre, and samples of both contained nearly 40 per cent protein and less than 0.1 per cent total alkaloid.

Mr. T. R. Ream of Sutton, Sandy, Beds told me that in 1949, on Sandy Heath, there was no rain from the time of drilling the sweet lupins until harvest. They yielded 5 cwt. of seed per acre. In 1950, on 8½ acres of the poorest blowing sand district, he had 15 cwt. of seed per acre, (protein 34–36 per cent and alkaloid content 0.88). Pigs fed up to 10 per cent of their diet on lupin grain did well. The milk yield of cows fed at the rate of 7½ per cent lupins in their home-grown food, went up half a gallon. He believes that sweet lupins are the answer to protein shortage on light land.

Mr. K. Bolton of Bragenham, Beds, grew sweet lupins in 1948. Drilled on June 4 at 80 lb. per acre, they did extraordinarily well on extremely poor sandy soil of *p*H 5.3. They gave 8–10 tons of greenstuff per acre in September. They had no manure. He made them into silage which showed 23 per cent protein in the dry matter, and two-year-old yarded cattle wintered well on it.

Failures with sweet lupin have been reported at various places, but usually these seem to have been due to such causes as sowing too late in a very dry spring, damage by rabbits, smothering by weeds, seed of bad germination, or soil too heavy. Most of these reasons for failure appear to be avoidable. Some of those who have tried sweet lupins recently had no previous experiences of the crop and may not have fulfilled all the conditions necessary for success.

A German pamphlet (9) states that sweet lupin silage is better than clover silage ; the silage is made out of chaffed lupins with molasses, and it is claimed saves up to 2–3 lb. of concentrates per cow per day. Capt. Bevan-John, expressed the opinion that the lupin, especially the non-splitting Weiko variety, can save many dollars for Britain when used as a concentrate for cows. From various trials there would appear good reason to believe that sweet lupin grain can take the place of other protein-rich concentrates, and the green plant, whether fresh or as silage, is also a valuable food. The fungus diseases *Fusarium* and *Botrytis* have caused damage to lupins occasionally.

The writer wishes to acknowledge the valuable assistance he has received from many persons in addition to those mentioned, especially Dr. A. Eden, who has given much information regarding the composition of lupins.

References

1. *Journal of Agriculture, Western Australia*, December, 1947, 302.
2. *Australian Agricultural News Letter*, March, 1951, **13.**
3. *New Zealand Journal of Agric.*, August, 1942, **15.**
4. *Canterbury (N.Z.) Agric. Coll. Bulletin* 15.
5. *Agriculture*, 1944, **51,** 129.
6. *J. Min. Agric.*, 1920, **26,** 982.
7. Ibid., 1925, **32,** 316.
8. *Agriculture*, 1941, **48,** 164.
9. What the farmer ought to know about sweet lupins. *Der Saatgut-Erzengungs-Gesellschaft m.b.h.* Berlin, W35 Lutzowstrasze, 119-20.

FARM TRACTORS

THE results of the farm machinery census taken in January, 1950, were published last year but the following detailed analysis of the numbers of farm tractors in Great Britain may be of interest.

Table 1

Farm Tractors in Great Britain (January, 1950)

	England and Wales			Scotland			Great Britain			
	Owned by Farm'rs	Owned by Whole-time Con-tractors	Owned by County Agric. Exec. Cttees.	Owned by Farm'rs	Owned by Whole-time Con-tractors	Owned by Dept. of Agric. for Scot-land	Owned by Farmers	Owned by Whole-time Con-tractors	Owned by County Agric. Exec. Cttees. and Dept.of Agric. for Scotl'nd	Total
Tracklayers										
Over 6 h.p.	11,674	366	1,424	1,172	107	116	12,846	473	1,540	14,859
6 h.p. and under	3,070	3	8	228	3	—	3,298	6	8	3,312
Wheeled Tractors										
3 and 4 Whe'ls	237,374	2,600	5,428	31,274	1,071	625	268,648	3,671	6,053	278,372
1 and 2 Whe'ls	33,030	119	165	2,327	22	—	35,357	141	165	35,663
TOTAL	285,148	3,088	7,025	35,001	1,203	741	320,149	4,291	7,766	332,206

Examination of the forms completed by farmers threw some interesting light on how the tractors were distributed amongst holdings of different sizes, and on the number of holdings on which there were no tractors at all. The following tables show how these tractors were distributed among the various size groups, taking into account the facts that all holdings consisting of only rough grazings are included in the under 5-acre group ; holdings farmed by County Committees are excluded ; and holdings in the same ownership have been combined and included in the appropriate larger size-group. The tractor figures allow for these adjustments. From Table 3 can be seen the tractor strength on farms in three broad size groups. It should be noted that many of the holdings in each size-group carrying the larger number of tractors are occupied by contractors or institutions whose tractor strength is much greater than that necessary for the ordinary farming of their own land. It has not been found possible to exclude tractors used for such special purposes.

Table 2

Distribution of Tractors Owned by Farmers in England and Wales (January, 1950)

Holdings Size-Group *acres*	No. of Holdings in Group	No. of Holdings in Group without a Tractor of any kind	No. of 3- and 4-wheeled Tractors in Group	No. of 1- and 2-wheeled Tractors in Group	No. of Tracklayers of 6 h.p. and under in Group	No. of Tracklayers of over 6 h.p. in Group
Under 5	79,056	69,350	2,300	9,025	500	260
5– 14	71,000	56,450	7,800	10,100	1,000	745
15– 19	17,478	12,800	3,950	1,750	215	270
20– 29	26,964	17,770	9,100	2,125	225	395
30– 49	40,143	20,170	21,400	2,150	235	525
50– 99	59,401	16,660	50,150	2,925	230	960
100–149	30,662	4,210	38,200	1,600	150	790
150–299	33,302	2,290	62,000	2,200	265	2,385
300–499	9,051	250	26,050	745	130	2,350
500–699	2,136	35	8,150	225	45	1,200
700–999	966	20	4,620	125	35	885
1,000 and over	499	5	3,650	60	40	905
TOTAL	370,658	200,010	237,370	33,030	3,070	11,670

Table 3

Farms Grouped by Tractor Strength England and Wales (January, 1950)

	No. of Tractors on each Farm								No. of Farms with Tractors
	1	2	3	4	5	6	7–12	13 and over	
	Number of Farms								
Under 50 Acres									
Tracklayers over 6 h.p.	1,865	114	21	5	2	2	3	1	2,013
Tracklayers 6 h.p. & under	1,998	97	4	1	—	1	—	—	2,101
3- and 4-Wheeled Tractors	35,726	3,519	492	172	61	12	29	4	40,015
1- and 2-Wheeled Tractors	16,403	3,106	655	120	27	4	5	—	20,320
50–99 Acres									
Tracklayers over 6 h.p.	751	75	16	3	1	—	1	—	847
Tracklayers 6 h.p. & under	205	15	2	—	—	—	—	—	222
3- and 4-Wheeled Tractors	32,740	7,084	752	150	46	18	13	3	40,806
1- and 2-Wheeled Tractors	1,957	346	55	11	5	1	3	1	2,379
100 Acres and over									
Tracklayers over 6 h.p.	4,866	1,066	262	100	39	21	20	—	6,374
Tracklayers 6 h.p. & under	436	84	17	6	3	—	1	—	547
3- and 4-Wheeled Tractors	23,977	26,446	10,910	4,061	1,484	682	588*	64†	68,212
1- and 2-Wheeled Tractors	2,264	763	166	53	22	5	17	8	3,298

*Comprises: Tractors on each farm	7	8	9	10	11	12			
No. of farms	254	141	78	54	30	31			
†Comprises: Tractors on each farm	13	14	15	16	17	18	19	20	over 20
No. of farms	18	10	12	6	3	5	1	8	6

Tractor Statistics by Fuel Types The census returns completed by farmers do not show what kinds of fuel are burnt in tractors, but a fairly reasonable estimate of the types in use at any time can be made from an examination of tractor supplies in the preceding years, covering both home production for the home market, and imports. In preparing the following table it has been assumed that tractors of all fuel types have been scrapped at the same rate, and there is, at present, the unknown factor as to the extent to which conversion units have been fitted to petrol tractors to enable them to burn P.V.O. As supplies are distributed over the whole of the United Kingdom estimates of the numbers in use in Northern Ireland have been added to the figures for Great Britain given in Table 1.

Table 4

Tractors in Use in the United Kingdom in January, 1950
Fuel Types

	Diesel	Petrol	P.V.O.	Total
Tracklayers over 6 h.p. ..	7,507	3,794	3,779	15,080
6 h.p. and under ..	—	3,320	—	3,320
3- and 4-wheeled	7,141	42,954	243,275	293,370
1- and 2-wheeled	—	36,120	—	36,120
Total	14,648	86,188	247,054	347,890

Table 5

Supplies of Tractors to the Home Market (United Kingdom) 1950
Fuel Types

	Diesel		Petrol		P.V.O.		
	Home Production	Imports	Home Production	Imports	Home Production	Imports	Total
Tracklayers over 6 h.p.	384	122	175	3	227	—	911
6 h.p. & under	—	—	259	—	—	—	259
3- & 4-wheeled	2,253	63	7,984	1	24,953	—	35,254
1- & 2-wheeled	—	—	14,363	—	—	—	14,363
Total	2,637	185	22,781	4	25,180	—	50,787

Detailed statements of the distribution of tractors in Scotland will appear in the forthcoming Autumn number of *Scottish Agriculture*.

FARMING AFFAIRS

Fertilizers and Fertility

Owing to the smaller supply and greater cost of fertilizers, farmers will have to strive harder than ever to maintain and, where possible, increase their output. They will have to give more attention to the fundamentals of fertility—cultivation, drainage, lime, farmyard manure and humus. We cultivate to obtain a favourable seedbed and to provide the plant with suitable conditions of anchorage, moisture, air, temperature and soil nutrients, and to control competition with weeds. By ploughing deeper in suitable circumstances we can often secure a cleaner seedbed, as well as extended range for plant roots. Most cultivated plants need a well drained soil. Grass is no exception. The harmful effects of waterlogging, whether on arable or on grassland, have, this year, been apparent to all. Anything we can do to rectify defective drainage will make for higher production. Lime is one of the most important factors in soil fertility. It is an essential plant food, and unless it is present in suitable quantity, soils cannot produce good crops. Herbage rich in lime is particularly important for the production of bone and milk. When the crop is removed from the land as hay or dried grass, the soil will gradually be depleted of lime. In acid soils fertilizers are seldom fully effective. Added phosphates are, sooner or later, converted into unavailable forms. Without adequate supplies of lime beneficial soil organisms, including those responsible for the breakdown of organic matter, fail to function properly. On pasture this leads to a gradual building up of a mat of peaty matter, which inhibits the growth of clover and the better grasses.

Most, if not all, farmers will agree that livestock play a very important part in maintaining soil fertility. This is true whether they are regarded as makers of farmyard manure or as perambulating dung carts. Dr. G. A. Cowie, reviewing the result of the Back House Field Rotation Experiment at Cockle Park (AGRICULTURE, July, 1946), records that "with 15 tons of good dung per acre, applied to the swedes, the only fertilizers required to raise the yields to their maximum were basic slag (5 cwt.) or superphosphate (3 cwt.) for the roots, and sulphate of ammonia (100 lb.) for barley and oats". The rotation is an ordinary four-course of swedes—barley—hay—oats, and the data examined covered five rotations. True, the dung was of high quality, being derived from cake-fed bullocks in a closed yard. The cake will have contained plant food from the land overseas where the linseed or cotton was grown. We do not increase the total plant food on the farm when we feed our animals solely on home-grown produce, although we may transfer it from one field to another. We cannot, therefore, in present circumstances, restrict our use of fertilizers to the extent indicated by the Cockle Park experiment. But we can contrive ways and means of reducing avoidable losses in the conservation of farmyard manure. Although now of poorer quality than formerly, farmyard manure is still an invaluable source of humus, and we cannot have too much of it. We ought to be treading down as much straw as possible, making good its deficiency in nitrogen with one or other of the nitrogenous fertilizers. Although now much dearer per ton, nitrogen has the advantage that a little goes a long way.

The long ley is also a valuable source of humus. If properly laid down and well grazed, it is a very effective means of enriching the land. In this connection two things are indispensable—phosphate and wild white clover. It is not invariably necessary or practicable to plough up old pasture. Sometimes as such it is more serviceable than ley, and it can generally be improved at relatively little cost. On light chalkland, for instance, nothing is so

effective as farmyard manure or animal excreta resulting from winter foddering when either is supplemented by phosphate.

J. G. Stewart

Farming Cameo: 10. Truro, Cornwall

Although Truro is a city by virtue of its fifty years old cathedral, and is the administrative centre of Cornwall, it is nevertheless situated in the centre of one of the best farming districts of the county, and its large, well-equipped cattle market adds to its agricultural importance. On the north-west side the district is bounded by rather poor, thin, spar soil, which overlies mineral deposits, and on the north by a belt of fairly heavy clay, the remainder of the area consisting of relatively fertile loam. Several kinds of farming are therefore found over the 73,500 acres of the district. Of this area some 26,750 acres are arable, the remainder permanent and temporary grass in roughly equal proportions. Of the substantial head of stock carried, there are about 32,800 cattle, 11,000 pigs, and 23,000 sheep,

To the north-west of Truro, stretching to the Atlantic sea-board, the soil is thin and rather poor. Here smallholdings produce a quick turnover from milk production, pigs, and poultry. These holdings range mostly from 10 to 60 acres, the smaller ones having been started by the Cornish miners to augment their weekly pay packets on which comparatively large families were raised ; indeed, many of the 60-acre holdings originally existed as three or more smaller holdings. Because of the size of the very small holdings (5-20 acres), it would be almost impossible to make each one self-sufficient and, at the same time, economic. Incidentally, there is a belt of wind-blown sand lying along the coastal strip which is invaluable to the farmer because of its lime content, and is a source of local supplies.

On the northern and eastern sides, a more fertile soil is found with the clay belt running through it. Traditionally this area produced fat cattle (North and South Devons) and fat lambs (South Devons and Devon Longwools) from large areas of grass, rape, swedes and corn, but of late, attention has been focused on milk production, and breeding and management are being continually improved. The South Devon is giving way to the Freisian, Ayrshire and Shorthorn, artificial insemination being a very real force in the improvement of the dairy cattle and milk yields of the area. At the same time, some means of reducing feeding costs are sought, and to this end more attention is being paid to the better use of grassland, either by making silage for winter milk or by strip grazing for summer milk. A fairly substantial acreage of corn is grown, together with cash crops such as maincrop potatoes, broccoli, and some sugar beet.

The south side is bounded by the English Channel, where a milder climate prevails ; the soil is a fertile loam. Two kinds of husbandry are found, necessitated in no small measure by the existence of the River Fal. Even though the milder climate is largely suited to market gardening, transport costs are prohibitive on the eastern side of the river, notwithstanding the shorter journey via King Harry Ferry. South-west of Truro market gardening is very prominent, and holdings of 5-20 acres are in the majority. A mild, dampish climate promotes early vegetables and flowers, with a very little fruit growing, but here also livestock production, either for milk, pigmeat, or eggs, is very evident, because of the greater need of humus on these intensive holdings. On the other side of the River Fal, to the south-east of Truro, lies the lovely Roseland district of Cornwall, with its very attractive landscape. Traditionally this was fat cattle and sheep country, but now milk production is the most important feature ; the old-time sheep farmers

are very jealous of their flocks which are still retained on many farms, even though the original South Devons are giving way to the Down breeds. Since the climate is mild, early potatoes are normally an important cash crop, together with maincrop potatoes, broccoli, and some sugar beet.

If a bias towards livestock production is noticed, this is as it should be. On account of the high rainfall and the moderating influence of the Gulf Stream, the climate is eminently suitable for grass production, and the greatest proportion of the human food of this district is being produced from the cheapest crop on the farm.

W. R. B. Carter,
Assistant District Advisory Officer

Crop Protection by Modern Science To appreciate fully the extent to which pests and diseases ravage our crops, nothing less than a world-wide view is called for. On the one hand, we see the world's population steadily expanding, and on the other, loss of agricultural land by erosion, flooding and industrialization. It is literally vital, therefore, that every weapon forged by modern science should be employed against insect pests, and harmful fungi, bacteria and viruses which, between them, it is probably true to say, destroy as much food in the field and in store as would make good the world's present deficit.

Sir John Russell, in his opening paper to the International Crop Protection Conference organized by Plant Protection at its research station at Fernhurst on June 26-28, surveyed the problem and the means which science has placed in our hands to deal with them. There are physiological and cultural methods of avoiding attacks by pests and diseases. Any cultivation or manurial device that throws plant and organism out of step protects against attack. The early sowing of oats to avoid frit fly is one example. Another is shown by the work of H. F. Barnes at Rothamsted in the control of gall midges on meadow foxtail by cutting back the grass a few weeks before flowering—the period when the midges lay their eggs—so putting the flowering stage and the midges' activity out of step. In this way damage was reduced from 90 to 10 per cent. The plant breeders help too in the selection and breeding of different varieties and strains to achieve resistance to disease. Rowland Biffen's work at Cambridge in the early years of this century is outstanding. He worked with wheat, which is well suited to genetical experiment, and showed that some of its more morphological characters (such as roughness of chaff and colour in the seed coat) were simple Mendelian characters. He then proceeded to find out whether resistance to Yellow Rust was a similar amenable character. It was ; and he produced rust-resistant Little Joss by crossing a Russian Ghirka wheat resistant to rust with Squarehead's Master, an old English variety with some admirable qualities but unfortunately susceptible to rust.

Sir John also quoted instances of plant breeding against insects, the most notable of which in this country was the breeding of new apple stocks resistant to woolly aphid. In the Sudan, R. D. Knight is putting longer and thicker hairs on to the leaves of the cotton plant to prevent the sucking Jassid insect from reaching the cells.

But apart from the physiological and biological methods of control, we are increasingly indebted to modern chemistry for the many powerful insecticides, fungicides and seed dressings with which direct action can be taken in the field. With selective insecticides particularly, recent advances have been spectacular: DDT and BHC (benzene hexachloride) are two which immediately come to mind. Still more potent are the synthetic organo-

phosphorus compounds like HETP, TEPP and parathion, the latter of special value against plant-feeding mites of the red spider type.

"The present century," said Sir John, "has seen an unprecedented increase in our knowledge of insect and fungus pests and in the means available for combating them. But there has also been an enormous increase in the number of pests and in their recorded prevalence. To some extent this is due to closer observation and better diagnosis : some of the diseases may be of long standing but only recently studied, such as Eyespot and Take-all of wheat. Many of them have come in from other countries, and modern transport is so rapid and multifarious that permanent exclusion of any pest capable of living in our conditions and feeding on any of our crops is extremely difficult, if not impossible. . . The conditions of our time require high levels of output of food from the land, and in attaining these we are perpetually disturbing Nature's balances and coming into unexpected difficulties. The plant breeder's latest successes may succumb to a new strain of the fungus he thought he had defeated. The agronomist may find his new intensive methods lead to soil deterioration or even erosion. An irrigation scheme may be a triumph of modern engineering, but it may speedily be followed by waterlogging, salting and other soil troubles. It is as true today as when Horace wrote : 'You may expel Nature with a pitch-fork, but she always comes back again'. . .

"The plant protector started as a priest armed with incantations, a sheep and a reddish sucking puppy for sacrifice : he has developed into a modern scientist equipped with well-founded knowledge and efficient appliances both of which are constantly widening and improving. Close, careful observation, clear thinking and a broad-minded approach to his problems still remain the greatest assets in his work."

The Hannah Dairy Research Institute The story of the inception and growth of the Hannah is told in an attractive booklet—*The Hannah Dairy Research Institute : Its Origin and Development* 1928–1951—which has been published to mark the occasion of the opening of extensions to the buildings. Until 1918 only one Dairy Institute —the National Institute for Research in Dairying, at Reading—had been set up, but it was soon realized that a much greater proportion than before of the country's resources must be devoted to the development and application of scientific research, and in 1927 it was decided to establish an institute for dairy research in Scotland.

The early establishment of the Institute was made possible by the gift of John M. Hannah of Ayrshire of the estate of Auchincruive for the joint purposes of agricultural education and research. The greater part of the estate was given to the West of Scotland Agricultural College, but the adjoining farm of Kirkhill was made available for the new research institute. In recognition of Mr. Hannah's generous gift, the Institute was named after him, and the Development Commissioners made a capital grant of £15,000 for the building and equipment of new laboratories, for the modification of the farm buildings, and for stocking the farm. Building began in November, 1929, and the new premises were opened on April 25, 1931, by the Rt. Hon. William Adamson, M.P., then Secretary of State for Scotland. The work of the Institute, however, actually began in 1928, when the first permanent member of the staff was appointed, headquarters being housed temporarily in the Physiological Institute of Glasgow University.

The shortages resulting from the second world war focused attention on the need to develop scientific research to the utmost, particularly in respect of agriculture and livestock products, and it became necessary to enlarge the Institute. Plans were therefore made to extend the laboratory buildings considerably and provide for a substantial increase in staff, the cost to be covered by a capital grant from the Department of Agriculture for Scotland. On April 20, 1951, the completed extensions were opened officially by the Rt. Hon. Hector McNeil, M.P., Secretary of State for Scotland.

Fowl Pest (Newcastle Disease) in Brooder-age Chicks The symptoms of Newcastle disease in young stock sometimes differ from those shown by older birds. Chicks of brooder age suffering from the virulent form of the disease show symptoms very similar to those of affected older birds. The young chicks appear sleepy, they are down on their hocks, and their eyelids are partially or fully closed. Mouth-breathing, gasping and a gurgle are usually present, and the chicks often fall over on their side, gasping for air.

With the milder form of the disease, the usual symptoms among affected chicks are mouth-breathing, gasping, sneezing, coughing and rattling or crackling sounds. In most outbreaks nervous symptoms appear a few days after the onset of the respiratory distress. Very young chicks show profound stupor, and are down on their hocks, with head depressed and eyes closed. Some chicks seem unable to use one or both legs and remain lying on their sides. Frequently other nervous symptoms, such as twisting of the neck and staggering, are noticeable. Handling of the chicks may intensify the nervous symptoms. The death-rate varies from 1 to 60 per cent, and it may even rise higher.

When young chicks display a sleepy condition, associated with respiratory or nervous troubles, Newcastle disease should be suspected.

BOOK REVIEWS

British Farming. W. B. MERCER. H.M.S.O. 3s. 6d.

This book is described in its sub-title as "An illustrated account of all branches of agriculture in England, Scotland, Wales and Northern Ireland : a story of progress in providing food from Britain's fields." It is all this and more. For, not only are its 96 well-illustrated pages compact with an authoritative and comprehensive survey of the origin and present variety of British agriculture, but it is very well written.

In the opening chapter, the author, who was assisted by a galaxy of well-known experts, leads us, in 14 pages, through 2,000 years of British agricultural history. Then follow chapters on dairy farming, beef, sheep farming, arable farming, the ploughlands of Scotlands, pigs and poultry, market gardening, and Northern Ireland.

A descriptive writer on agriculture always faces a dilemma. If he considers each region separately, then some repetition is unavoidable or the reader with an interest in, say, dairy cows has to scamper all over the country,—and the book—looking for them. If the author takes his subject product by product, he cannot easily paint a picture which shows how the types of farming in each district tie in with local geographical and economic circumstances. Mr. Mercer, however, has evolved a successful compromise. He has, as it were, painted a portrait of each important character in the pageant of British farming and set it firmly in its own and proper landscape. Thus the first scene of his chapter on sheep is set in the Scottish Highlands, where he tells us about hill farming methods, the Blackface and the Cheviot. Thence, after excursions to the Border country, the Pennines and Wales, the author descends surely and succinctly through the uplands to the lowlands. Similarly, the scene for the chapter on arable farming is mainly set in East Anglia.

This device has enabled Mr. Mercer to cover the ground rapidly but effectively. It has helped him to create an attractive panorama which a farming visitor from overseas or a townsman can readily take in at a glance without however compressing his subject-matter so much that the expert cannot relish each section in detail.

Thus when describing the stratification of our sheep industry he writes : " The course of the Scotch Blackface runs through the Border counties, where the Border-Leicester is introduced to give the so-called Greyface or Mule, which meets the Suffolk in the Midlands."

Then, after following the Cheviots, the Swaledales, the Welsh mountain sheep and the Exmoors down to the lowlands, he adds—in one of those vivid descriptive passages so characteristic of this book :

" But the main stream runs in three regions, mountain, upland and lowland. The vitality of our flocks is constantly being renewed by blood tested and tried on the wind-swept heights of Scotland, Wales and the Pennines."

This single quotation from an eminently quotable text serves to show that Mr. Mercer has written a classic which enables him to join that select band whose agricultural writings have long outlived the types of farming and ways of life they knew and described.

From Hesiod—the ancient Greek ancestor of all agricultural writers—to Daniel Hall, whose *Pilgrimage of British Farming*—though only 40 years old— reads so strangely today, the farmers of the world have depended on their muscles and draught animals. Today, to quote Mr. Mercer, " the ploughman no longer ploughs his acre and plods wearily home at the close of day. He ploughs four and five and goes home in top gear." And, as a living picture of an industry in top gear, Mr. Mercer's book should have a wide appeal. It is the kind of book which one would not only like to see on one's own bookshelf, but to give to a friend in town, to a nephew thinking about going into farming, or to a farmer friend in Australia. It seems a pity, therefore, that it should have only paper covers, for it deserves a more permanent protection. The publishers might well consider producing a special festival year gift edition in boards. For—looking a few months ahead—it would make an ideal Christmas present.

A. H. S.

Readings on Agricultural Policy (Edited by O. B. Jesness). Blakiston. 38s.

This volume, the first of a series, reflects the American agricultural scene and is addressed primarily, although not wholly, to an American audience. It comprises a collection of previously published articles pertaining to U.S. agricultural problems. The book is divided into four parts: Background, Price and Production Adjustment, International Trade and Relations, Land and Rural People. By its very nature, however, the standards achieved are mixed, ranging from articles which are frankly political in aim to those which carefully apply economic analysis to the range of problems which beset U.S. agriculture. It is these latter which make the book an interesting and worthwhile study.

Parts I and II are concerned to answer the impelling question arising from U.S. agriculture: given the premise that government policy must ensure that farmers receive an adequate share of the national income, how best can agricultural surpluses, resulting from this policy, be dealt with. The parity price and "ever-normal granary" methods of income maintenance are strongly condemned on the grounds that: (a) they have recourse to an historical scheme of price relationships which may bear no relation to existing conditions, thereby distorting both the flow of productive resources and consumer demands, (b) bases tend to be chosen which most favour agricultural interests, and (c) progress in farm technology is never taken into account. Thus so long as these policies prevail, agricultural surpluses continue to grow, and plans to limit production by acreage quotas tend to be negatived by more intensive farming.

As a solution to this dilemma, it is suggested that future prices of farm commodities should be estimated and the differences between the estimated and the subsequent free market prices paid directly to farmers. It is claimed that by this method, resources would be distributed according to consumer demands, while the government would retain control over farm incomes. The fact that it might necessitate unexpectedly large subventions to bridge the gap between forecast and market price is not discussed.

Part III is concerned with the above problems on an international plane. The buffer stock type of policy is generally favoured, as against restriction schemes and bilaterally arranged trading, but its shortcomings are not considered. And, in general, no new light is shed on these vitally important problems.

Part IV will be of interest to the student of U.S. tenure systems, particularly those prevailing in the south.

E.S.C.

Beef Cattle in Australia. Edited by Frank O'Loghlen. F. R. Johnston (Sydney). 21s. 6d.

The present meat shortage has focused considerable attention on the need to explore additional sources of supply. This book comes, therefore, at an opportune time. The Australian beef cattle industry is surveyed by experts in their own particular field and the subjects range from breeding to management and feeding, and the preparation for showing and finishing. Account is also given of the various beef breeds in the country and the history of individual herds. Apart from the usual British beef breeds kept, the development of Poll Herefords and Poll Shorthorns and the use of Red Polls and Zebus is of interest.

The brevity of the article on artificial insemination might be criticized and the chapter on the Queensland Beef Industry and Cattle in the Northern Territory might have been extended with advantage on account of their popular appeal. The graphs showing Australia's total beef supply—1 million tons, of which 770,000 tons are used by a population of seven million—not only shows the measure of the industry, but directs attention to its future expansion. The cost of stall feeding cattle is high in Australia as well as in the United Kingdom, but it is appreciated that high-class beef, fit to compete in the world's market, frequently requires " topping off". Distance and transport render the production of this class of beef difficult. Nevertheless, the chapters on Publicity and Propaganda recommending, *inter alia*, a National Livestock and Meat Board to overcome the haphazard state of meat distribution, shows frank recognition of the problems to be solved before the industry can expand in the Australian Market and compete with, or rival American products. This realization is a good augury for the future. The book will be of value to British breeders in showing the type of cattle best suited to Australian conditions and the possibilities of export and development of the industry.

H.T.

The Wood-Pigeon in Great Britain (A.R.C. Report Series No. 10). M. K. Colquhoun. H.M.S.O. 3s.

This report is not only a major contribution to the literature of economic ornithology but it is far the most comprehensive and valuable one on the life history of the wood-pigeon so far published. Since the inquiry of which it is the subject was directed, and the report itself prepared, by Mr. M. K. Colquhoun, sound scientific approach and meticulous attention to detail were to be expected, for in his field Mr. Colquhoun has few peers and no superior.

In the report there is much that will be new, even to the most ardent and experienced student of the wood-pigeon. Incidentally, some long-cherished beliefs have gone by the board, notably that concerning the large invasions of wood-pigeons from overseas. It seems now to be established that the huge flocks so often seen in this country in winter, hitherto considered by many observers to be composed of foreign wood-pigeons, are really Scottish birds which have come south for a time.

One thing, however, the report leaves unchanged—the harmful nature of the wood-pigeon in relation to agriculture and food production generally. This is one aspect of the wood-pigeon's character that has never been in much doubt, and the report supplies additional and convincing evidence.

The report concludes : "There is enough evidence to state confidently that there is no need to take special steps to control the wood-pigeon population in the near future. This is due to two war-time factors, the decreased shooting of predatory birds and the increased shooting of wood-pigeons, as a result of which it seems likely that the wood-pigeon population will decline to a lower level than has been known within living memory. How far these factors will continue to operate will depend on the recovery of the country after the war."

I believe that the last sentence of this paragraph is a vitally important one, and indeed I would suggest, with all deference, that it is a moot point whether the preceding ones are not already, to some extent, out of date, for several years have passed since the period covered by the report. It is hard to envisage so agile and wary a bird as the wood-pigeon remaining at the low ebb attributed to it, or to avoid the impression that a recovery is even now under way ; and as the report itself says, "Good mixed farming and small-scale forestry provide an ideal environment for the wood-pigeon."

However, Mr. Colquhoun and his band of enthusiastic helpers are indeed to be congratulated. It is greatly to be hoped that other reports of the same calibre will be forthcoming. If I might offer a suggestion, an inquiry on the starling would be both timely and valuable, for this bird seems likely to vie with the rook and the little owl as a subject of heated, if not especially well-informed, controversy.

F.H.L.

Botany : An Introduction to Plant Science. W. W. ROBBINS and J. E. WEIER. Chapman and Hall. 40s.

Botany has become an essential element in a liberal education as well as a specialist science basic to agricultural training, and in farm institutes, county colleges and other centres of adult education, lecturers find it necessary to combine both aspects. This combination has been successfully achieved by the authors of this admirable text-book. They deal with plant anatomy and classification, chromosome structure and the mechanism of inheritance, photosynthesis, photoperiodism, plant nutrition, water relations, hormones and vitamins. Based on a course of lectures given in the University of California to students of botany, agriculture, forestry and medicine, along with those from arts departments who find it convenient to take botany to satisfy general education requirements, the book emphasizes the effects of modern botanical discoveries on human life and activities.

The style is simple and direct and the arrangement of the text in double column makes it easy to read. It is profusely illustrated with excellent explanatory diagrams and photographs placed on the relevant pages.

Farmers and growers with some technical training will find it stimulating and refreshing to follow the new developments of plant science in such a readable form, and the general reader will discover much of interest. The book should prove a valuable addition to the libraries of agricultural colleges, farm institutes, county colleges, and county education committees.

M.M.

Lilies of the World. H. DRYSDALE WOODCOCK and WILLIAM T. STEARN. Country Life. 35s.

The publication of an entirely new book on the genus *Lilium* and several of its allied genera is an event of considerable importance to both botanists and horticulturists, who for many years have been studying the nomenclature and the cultivation of the many species, their varieties and numerous garden hybrids. This latest book was originally planned to be a third edition of *Lilies, their Culture and Management*, but in the course of collection over twenty-five years the subject-matter became so involved with new material that it became necessary to publish it as an entirely new book.

The major portion of the book consists of an alphabetical list of species, hybrids and variants of *Lilium*. Full descriptions are given of every known lily, together with its varieties and all the hybrids brought to the authors' notice. The notes on all these are clear and concise, and all essential botanical characters are given in plain English. So comprehensive are the details that there is no necessity to probe into the host of other references in regard to the bibliography of books and articles on lilies.

The closely allied genera *Cardiocrinum*, *Notholirion*, *Korolkowia*, and also *Nomocharis* are dealt with separately, and each species is described in detail. The authors have had the courage to separate the genus *Cardiocrinum* from *Lilium* and thus followed distinguished botanists such as Endlicher who proposed it as a sub-genus in 1836. Then Lindley gave it generic rank in 1846, and the Japanese botanist, Makino, in 1913 *Cardiocrinum giganteum* formerly *Lilium giganteum* of Wallich is the type of the genus now retained by the authors of this new work. In habit, foliage and flowers it is quite distinct from any other plant of the genus *Lilium*.

The bulk of the details of nomenclature is the work of Mr. William T. Stearn, who has devoted years of study to every phase of the genus *Lilium* and its allies and is now one of the leading authorities on many liliaceous genera and their species. Particularly impressive is the careful and thorough investigation of the authority for the name of each species, as is also the authoritative assembling of all the facts in regard to the large number of synonyms used by various botanists in the past. Priority in the date of publication of any name for a genus or species is the criterion which—by the rules laid down by the Botanical Conference—can be accepted only if the name is properly published together with a complete description in botanical terms, preferably in Latin or Greek.

The book is well illustrated by photographs and line drawings, and nearly all the species are shown. Most of the cultivated species of *Lilium* are depicted from living plants, but a few photographs are reproductions from the material in various Herbaria of the actual type specimens of rare species not yet introduced.

The notes on the culture of each species, soils and situation are, in general, sound and practical, so that even a beginner can pick up the book and obtain expert information on the history and culture of every lily. There is a special article on hybridization, also one on insect pests and diseases, with particular emphasis upon the dangers of Mosaic disease.

This latest work on one of the most beautiful groups of allied genera and species of plants of the world will long be treasured as a standard work of authority and importance on a subject of wide interest to both botanists and horticulturists.

C.P.R.

Biology. P. D. F. MURRAY. Macmillan. 25s.

Although written primarily for medical students, this book also supplies a good background of pure science in biology for students of other applied sciences. It deals with botany, zoology and physiology, and much of the information it contains makes it suitable for the use of agricultural or veterinary students before entering on a degree course at a university.

After discussing the simple unicellular animals and plants, it goes on to describe at some length the anatomy and physiology of different types such as the earthworm, cockroach, dogfish, frog and rabbit. The vegetative structure and life cycles in various types and in different forms of flowering plants are also outlined. The structure of protoplasm and vertebrate tissues and their functions, as well as the elements of embryology of the frog, chick and mammals are given in some detail. There are also short accounts of growth, genetics and evolution, the latter including the geological epochs and fossil forms as illustrated by the foot of the horse.

The transformation and uses of organic materials from plant to animal and animal to plant are considered, and on the plant side accounts are given of fungi, such as rust in wheat, bacteria and viruses. The life histories of some animal parasites such as the liver fluke are also described.

This is a very comprehensive list, but it is the sort of knowledge which, if acquired before entry to a university or college, would enable the agricultural or veterinary student to appreciate better the lectures given there. Much time is often consumed in teaching the elements of pure science to students before the direct application of science to agriculture can be undertaken, and in this respect the book should fill, so far as biology is concerned, a long-felt requirement.

The book is well illustrated with some 380 figures, mainly original, which add greatly to its value for the student.

J.H.

Printed in Great Britain under the authority of HIS MAJESTY'S STATIONERY OFFICE
by Staples Printers Limited at their Kettering, Northants, establishment.

(746) Pn. 80 18/D31 K127 7/51 SP/TBH **Gp.521**